(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE

140 NASSAU STREET, NEW YORK

J. S. BONSALL,
Business Manager.

R. V. WRIGHT, } Editors.
E. A. AVERILL, }

NOVEMBER, 1908

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CONTENTS

Standard 50-Ton Gondola Car, Virginian Railway	413*
Annual Meeting, Society for Promotion of Industrial Education	415
American Railway Employees' and Investors' Association	415
Locomotive Characteristics, by Lawford H. Fry	417*
Tube Blowing Device, Prussian State Railways	418*
Railway Engineering and Maintenance of Way Assoc. Convention	418
A Rational System of Numbering, by C. J. Morrison	419
Combined Reciprocating and Turbine Engine in Steamship	419
Steel Passenger Equipment, Form III, Underframe, by Chas. E. Barba and Marvin Singer	420
Melting Snow at Frogs and Switches	423
Proposed Freight Tunnels for New York City	423
Transatlantic Speed Record	423
Daily Railway Review	423
Details of DeGlehn Compound Locomotive, Paris-Orleans Railway	424*
Forging Castle Nuts, Chicago, Milwaukee & St. Paul Ry	427*
Track Supply Exhibition	427
British Railway Accidents, 1907	427
Track Prizes on Pennsylvania Railroad	427
General Service Freight Equipment Car	429*
Railroad Business Association	431
Car Shortage on the Canadian Pacific Railroad	431
Reducing Grate Area	432
Design of Gondola Coal Car	432
Organization	433
Value of Good Reading	433
Locomotive Characteristics	433
Setting Walschaert Valve Gear, by R. S. Mounce	434*
New Terminal Station in Chicago	435
Meeting of the A. S. M. E.	435
With the Railroad Clubs	436
Some Suggestions Concerning Railroad Clubs, by L. H. Turner	437
Self Improvement, by W. H. White	438
Railroad Fuel Men to Organize	438
Brotherhood of Locomotive Engineers Building	438
Comparative Trials of Simple and Compound Locomotives	439*
Locomotive Wheel and Flange Lubricator	442*
Bureau of American Manufacturers in Europe	442
Master Mechanics' Scholarship	442
Gasolene Engine vs. Electric Motors	442
Gasolene Motor of Unusual Lightness	442
New 4-Foot Radial Drill, Dreses Machine Tool Co	443*
Electricity Increases Traffic Capacity	444
Monorail Electric Railroad	444
New Design of Young Valve and Gear, D., L. & W. R. R.	444*
Modern Steel Car Plant, Bettendorf Axle Company	446*
Sight Feed Air Cylinder Lubricator	447*
14-Inch Crank Shaper, John Steptoe Shaper Co	447*
Mexican Railway Mileage	447
Chinese Railway Mileage	447
Triple Geared High Speed Radial Drill, American Tool Works Co	448*
Two Valuable New Tools, Cleveland Twist Drill Company	449*
Compact Electric Crane Trolley	449*
Extent of Pintsch Gas Lighting	450
Freight Car Situation	450*
Books	450
Personals	451
Catalogs	452
Notes	452

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A 100,000 lb. steel gondola car for the Virginian Railway, which is illustrated on page 413 of this issue, was designed for conditions of service which will be particularly severe. This new railway is to be almost exclusively a coal handling road and no expense has been spared, in building and equipping it, which would reduce the cost of handling or transporting this product. The roadway has been constructed to permit the economical handling of trains weighing 6,000 tons behind the locomotive; the cars are of as large capacity as previous experience has shown to be

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desirable under present conditions; the distribution of cars in the yard will be by the most rapid and hence the most severe method and the loading and unloading will be performed by the most modern methods for rapid and cheap handling. In other words the proposition put up to the car designer in this case is probably more difficult than he has been called upon to meet before and it represents the very latest present day requirements for a coal carrying car. For this reason the design is interesting, more especially as the conditions which it will meet will without doubt soon become general for cars of this class and it will be necessary for all such cars to stand them.

The most prominent features in the design, as a whole, are the unusually strong, rigid sides and ends and the very heavy center sills. The finally accepted design, as shown on page 413, is considerably lighter than was that which was published some time ago, but this decrease in weight has been obtained with little or no sacrifice of strength and possibly with an increase of flexibility. The center sills are nearly 34 sq. in. sectional area, a figure which equals that used on many steel passenger cars of half again the length, and should certainly prove to be amply strong for even the most severe hump yard mis-handling. The ends have been arranged to stand the same service and the sides are designed to withstand treatment in a Hewlitt car un-loading machine where they will have to support at eight points, four on each side, not only the weight of the car itself but also a pressure equal to the weight of the lading which the reacting of the springs will place upon it when the load is discharged.

VALUE OF GOOD READING.

It is with considerable pleasure that we reproduce in this issue a portion of an address on "Self-Improvement" made before the Richmond Railroad Club by W. H. White, president of the Richmond, Fredericksburg & Potomac Railroad. His suggestions as to the broadening and uplifting effect of good reading have been forcibly brought home to us during the past week by two acquaintances who dropped in at different times for a little chat with the editors. Both of these men were thrown on their own resources at the age of thirteen; both hold splendid positions in the motive power department and their names are familiar to the readers of this journal; both are hard workers and have made splendid records, and yet they have found time to surround themselves with good books and to devote more or less time to studying them; both are regarded as men of culture in the communities in which they live, and both belong to clubs which are noted because they are frequented and supported by men of culture. One of the men especially spoke enthusiastically of the broadening and uplifting effect which the reading and studying of good books had on him.

Are we so wrapped up in our work that we neglect to avail ourselves of intimacy with the master minds in literature? Is there not such a thing as giving too much of our time to the occupation by which we earn our daily bread, so that our mental growth is unsymmetrical and we run the danger of becoming narrow-minded? Will not a course in general reading broaden us out so as to make us of greater value to our employers and increase our earning power and our influence in the community? It is not so much the amount which we read as the quality, and the thought which we give it.

ORGANIZATION.

Last month we commented on the most efficient form of organization. While the railroads and industrial establishments remained comparatively small the need of this was not so strongly felt, since the head of the concern was in most cases not far removed from the men in the ranks and could easily familiarize himself with the workings of the entire organization. But conditions have changed. These concerns are now so large that there is a great gap between even the heads of the departments and the men in the ranks. Railroads, for instance, have grown so great that there are many workmen who have never seen the man at the head of the department in which they work. Under these conditions it is essential that the machinery of organization be so carefully designed that all unnecessary friction and waste will be eliminated and that in effect, if not in fact, the officials will be almost as closely in touch with the workmen as under the old conditions.

But right here we are confronted with a problem which is even more important than that of evolving a proper form of organization. It is to build up a spirit of team work and co-operation which will permeate the entire organization and will force down out of sight department lines, the men working enthusiastically for the good of the road as a whole. It means that there will be a spirit of enthusiasm throughout the organization. It is impossible to estimate what this would mean in dollars and cents, but surely its value cannot be overlooked by even the most selfish and self-centered official. What a pleasant shock it would be for the railroad directors and stockholders if, say for three months, all of the unnecessary friction and useless bickering between their servants (on some roads) could be eliminated and each employee could consider himself as a heavy stockholder. If only a little bit more of the Golden Rule could be injected into the average railroad organization the result would be surprising.

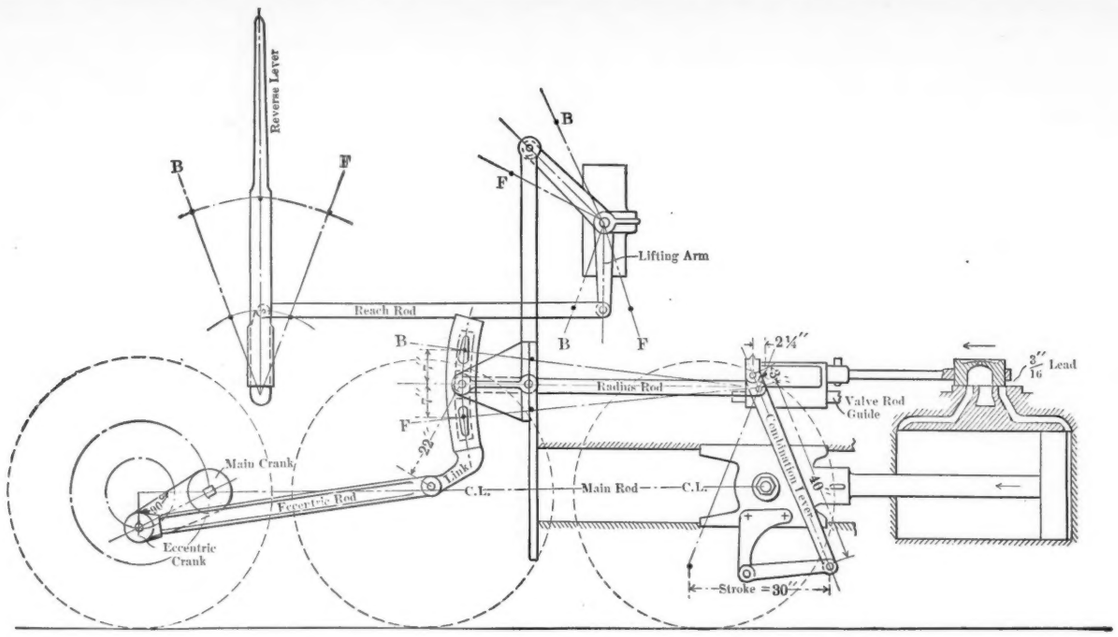
Fortunately there are mechanical departments on some roads in which there is more or less of this spirit of team work and co-operation. It is extremely rare, however, when one can find the happy combination of enthusiasm, team work and co-operation in connection with the most efficient form of organization. There is at least one road on which these conditions exist, and we hope in the next issue to place before our readers the details of what we believe to be the finest motive power department organization on this continent, if not in the world.

LOCOMOTIVE CHARACTERISTICS.

The diagrams presented by Lawford H. Fry on page 416 of this issue are arranged to give the information concerning the operation of single expansion locomotives which was given in a similar set of curves by the same author for balanced compound locomotives about a year ago (Oct. 1907). These curves permit the convenient and rapid determination of almost any desired information in connection with the operation of the locomotive under any assumed conditions. While the examples given by the author as an illustration, start with the assumption that the locomotive is capable of maintaining 60 per cent. of its maximum tractive effort at 150 revolutions per minute, under which conditions the water consumption, boiler efficiency, etc. are obtained, it is, of course, equally accurate when reversed, that is, by assuming or knowing a certain boiler capacity or efficiency is possible, to determine at what speed a certain proportion of the maximum tractive effort can be maintained and what cut-off will be required to do it. Such information would be valuable in connection with the preliminary investigation of the advisability of applying a standard boiler, the characteristics of which had been determined on one type of locomotive, to another type or size of engine. Application could also be made for an investigation of the alterations necessary to remedy an unsatisfactory design, etc.

The curves are also capable of giving considerably more information than they are designed to give by direct reading. A couple of examples of this are given by the author in connection with a constant horse power curve and the water consumed per horse power hour for any combination of cut-off and speed.

It will be noticed in the fourth section of this diagram that the author has differentiated between two classes of coal. This is a very important feature, which should be given very careful consideration. When using the curves for any known conditions to obtain accurate results it might be necessary to use other curves the relative location of which would depend on the chemical analysis and quality of the coal to be used. The reference given in the article will show the quality of the coal which determined the location of the curves in the diagrams.



ARRANGEMENT OF WALSCHAERT VALVE GEAR AS EXAMPLE FOR SETTING.

SETTING WALSCHAERT VALVE GEAR.

By R. S. Mounce.

The Walschaert valve gear is comparatively new in this country, and with this fact in view the following set of rules applied to a specific case, but which can of course be made general, may be of interest to many who are in charge of applying new gear, or in re-applying the gears during general repairs to an engine already so equipped.

Since in designing Walschaert gear, the foot of the link is backset in such a way as to equalize the valve travel with respect to top and bottom quarters of crank pin, if the engine is set square in full gear, it will be very close to square in running positions or positions of shorter cut-off. Because of this it is very good practice to adjust the various parts for full travel, then,

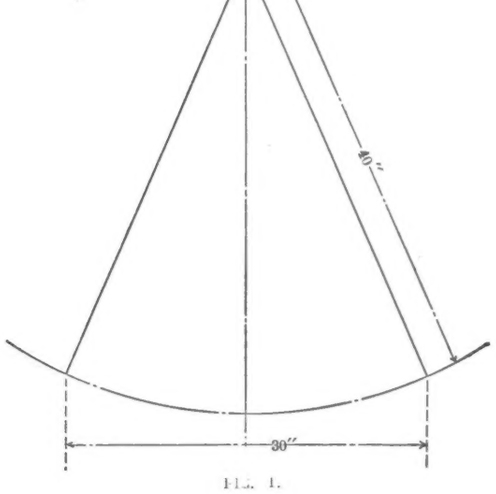


FIG. 1.

if desired, it is a very simple matter to run the engine over, with reverse lever in the running position.

In setting the valves on an engine with this gear, the full travel must first be made equal in both motions to a certain standard distance. There are several errors in the parts which may cause this to vary. The most convenient method for adjusting the travel is to shorten or lengthen the reach rods such an amount (which can be readily estimated by trial, or from the geometry of the mechanism), as to make backward and forward travel equal on both sides of the engine. In case, after the travel is equalized, the distance is too short, the stops will have to be moved on the quadrant, the front one ahead and the back one back, a proper amount to give the correct travel. After these adjustments have been made, the distance of the link block from the center of the link will be the same for both motions.

Since in this motion the return crank is approximately 90 degrees from the crank pin, the lead at dead center must be given by the combination lever attached to the cross head. The throw given by this lever should next be adjusted. The eccentric rods are removed and the links set exactly plumb or central. Now by rotating the main wheel, the amount of travel of the valve due to combination lever can be adjusted. In the assumed case the steam lap of valve =15/16", and the lead is to be = 3/16". This large amount is taken because, on the Walschaert gear, the lead cannot be increased when engine is running in the so-called "cut off" position, so to give a fair average to suit running and starting travel of valves, 3/16" is taken for the lead. Now it can

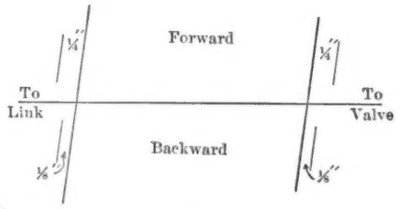


FIG. 2.

readily be seen that the stroke of valve due to the combination lever must equal 2 (15/16" + 3/16) = 2¼".

Assume that the stroke given in this particular case is 2⅛". It will be necessary to adjust the combination lever to make this stroke 2¼".

Now, referring to Fig. 1, from the principle of similar triangles 3:40 = 2¼:30 where 3" and 40" are lengths of combination lever arms and 2¼" and 30" are the stroke of valve and piston. Now according to this ratio, using 2⅛" instead of 2¼" the length of combination lever long arm comes out as 42.35" long, which is shown to be true by measurement. Now if the arm is adjusted from its incorrect length to 40", the travel will be such that when finally set the valves will have 3/16" lead.

The next step is to reapply the eccentric rods and again run

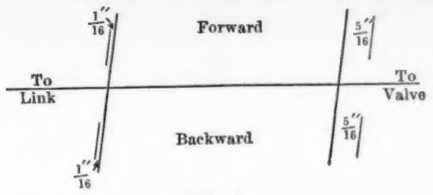


FIG. 3.

the engine over, catching the dead centers and making the corresponding tram marks on valve rod. Assume that the marks on the right side are as shown in Fig. 2. The forward motion has 1/16" too much lead, and the backward 1/16" too little. Since forward motion is direct and backward motion is indirect, the angle of advance of eccentric crank must be decreased, and this will also increase the angle for the backward motion. The lead must therefore be adjusted 1/16" (see large drawing for reason of using fraction 22/7), and to do this the eccentric crank must be moved toward the crank pin 22/7 × 1/16", since the link

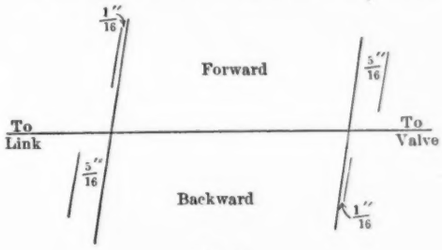


FIG. 4.

block radius in full travel = 7" and radius of eccentric rod pin hole in link is equal to 22". This change will make the lead correct and equal in both forward and backward motion.

The final step in the adjustment, namely, the adjusting of the eccentric and radius rods, is next. There are three possible cases that may came up, and they will be treated separately. A.—Eccentric rod correct and radius rod "out." Assume that on running the valves over, the marks on right are as shown in Fig. 3. This shows that to give same port opening on each end, that valve must be thrown ahead just ⅛". If the radius rod is

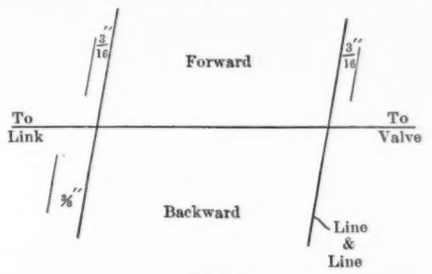


FIG. 5.

lengthened ⅛" the proper adjustment will be made. B.—Eccentric rod "out" and radius rod correct. Assume the marks on right side as shown in Fig. 4. Since forward motion is *direct*, the valve must be thrown ahead ⅛" to make it square. Now if eccentric rod is lengthened ⅛" × 22/7 the forward motion will be correct. The valve of the backward motion must be drawn back to make it square. Since the back motion is *indirect* the valve *will* be drawn back, if eccentric rod is thrown ahead or lengthened 22/7 × ⅛". So lengthening the eccentric rod 22/7 × ⅛" will make the valve correct in position. C.—This case is

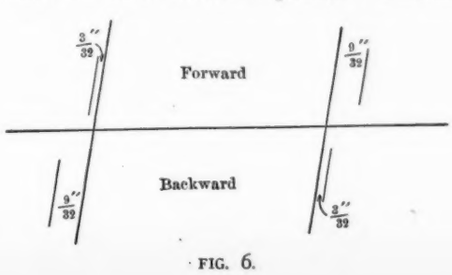


FIG. 6.

when both eccentric and radius rods are "out." Assume that the following marks are obtained when valve is run over on, say, the right side. First (Fig. 5) radius rod will have to be adjusted so as to give marks as in Fig. 6 (shorten radius rod 3/32"). Then using case in Fig. 6 eccentric rod will have to be lengthened 3/32" × 22/7. These alterations will make the valve square.

The above gives a sample case of alterations necessary for adjusting the valve motion of a Walschaert engine, and any case whatever can be adjusted by following a similar course of reasoning.

NEW TERMINAL STATION IN CHICAGO.

The New Chicago terminal station of the Chicago & Northwestern Ry. will occupy about four city blocks and will have its main front on Madison street, between Canal and Clinton streets. The cost of the building alone will be about $4,000,000, while the approaches (with elevated tracks) will cost about $8,000,000. The expenses for land and right-of-way will bring the total cost to about $20,000,000. The building will be of gray granite. The design is of the classic type, with a colonnade 120 ft. high forming the main entrance. The six main entrance stairways will aggregate a total width of 100 ft. There will be three main floors. At the street level, the main entrance will open into a concourse 100 × 250 ft., convenient to the ticket offices, baggage rooms, and special accommodations for immigrants. There will be a separate concourse and other facilities for the suburban traffic. On the second floor, level with the station platforms, will be the waiting rooms, the main room being 100 x 200 ft., and 80 ft. high, with a vaulted ceiling. The third floor will have ladies' rooms, barber shop, and other accommodations.

The present terminal station at Wells and Kinzie streets was built in 1882. An annex for suburban traffic was built a few years ago and additional tracks have been laid from time to time. The passenger accommodations and train facilities are, however, very inadequate for the present traffic. All traffic is throttled by having to cross a double-track swing bridge just outside the station, but this is now being replaced by a four-track Scherzer rolling-lift bascule bridge. There are now over 300 trains entering and leaving the station daily, and there is a very heavy suburban traffic.

The site is now being cleared, ready for sinking the foundation caissons, which will go down about 106 ft. It is expected to have the station completed by January, 1910. The architects are Frost & Granger, of Chicago.

THE HERRING-BONE ARRANGEMENT FOR ERECTING SHOPS.—It was my privilege to work out and see the completion of the only large shop in the States employing the "herring-bone" arrangement of erecting shop pits. This is a modification between the transverse and longitudinal plans. With such a plan the cranes are in constant use. When not transferring they are used in erection, and the proportion of time expended in the former service is relatively small even with fifty engines on the floor. Engines do not have to pass over each other, hence an economy in the height of the structure and of the lift. Cross-communication throughout the shop is uninterrupted, not as in the ordinary longitudinal plan. This shop has now been in operation four years, and the plan has the hearty approval of those best acquainted with its operation.—*C. A. Seley, Canadian Railway Club.*

MEETING OF THE A. S. M. E.—The November meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 W. 39th street, New York, on Tuesday evening, November 10. Mr. Franklin Phillips will give an address on "The High Powered Rifle and Its Ammunition," to be illustrated by lantern slides.

A SUCTION GAS-ENGINE OUTFIT is being tried out on the old English warship "Rattler," with a view of determining the practicability of this type of power for ship propulsion.

WITH THE RAILROAD CLUBS.

We should like very much to have an expression of opinion from our readers concerning Mr. Turner's "hobby," as mentioned in his letter on the next page, i. e., that the railroad clubs should appoint a joint committee on subjects and that each club should discuss the same subject during the same month.

Canadian Railway Club.—Next meeting, Tuesday, November 3, at the Windsor Hotel, Montreal, Can. Walter V. Turner, mechanical engineer of the Westinghouse Air Brake Company, will present a paper on "Brakes for Freight Cars from an Economic and Operative Point of View." It will include a review of the conditions affecting this phase of the brake problem and will be illustrated with lantern slides.

Mr. Thornton's paper on the "Chemistry of Rubber," presented at the October meeting, was largely devoted to the methods of procuring the crude rubber.

Bruce Robb, son of W. D. Robb, superintendent of motive power of the Grand Trunk Railway, and a former president of the club, was announced as the successful competitor for the first Canadian Railway Club scholarship at McGill University.

Secretary, James Powell, P. O. Box 7, St. Lambert, near Montreal, Can.

Central Railway Club (Buffalo, N. Y.).—Next meeting, Friday, November 13. At the time of going to press the subject to be discussed at this meeting had not been decided upon.

Secretary, Harry D. Vought, 95 Liberty street, New York City.

New England Railroad Club (Boston).—Next meeting, Tuesday, November 10, at the Copley Square Hotel. A paper on "Railroad Stations" will be presented by Henry B. Fletcher, architect of the Boston & Maine Railroad.

Secretary, G. H. Frazier, 10 Oliver street, Boston

New York Railroad Club.—Next meeting, Friday, November 20, at the Engineering Societies' Building, 29 West 39th street, New York City. W. J. Harahan, assistant to the president of the Erie Railroad, will speak on "A Search for Those Elements, the Proper Combination of Which Constitute the Successful Railway Official." This will also be the annual meeting of the club.

The proceedings of the September meeting, containing Mr. Emerson's paper on "Better Service at Reduced Cost" and the discussion thereon, have been received. An interesting addition to the paper, not printed in the advance copies, is a bibliography of leading articles relating to improved efficiency and economy of operations, as applied to locomotive tool equipments; railway shop tools, machinery and methods; alloy tool steel for high-speed metal cutting; shop methods and organization; labor efficiency and material economy.

At the September meeting the list of subjects to be presented up to and including the May, 1909, meeting was read. In commenting on this the president, Mr. Vreeland, said:

"It was only a few years ago when it was very hard to give out the subjects to be presented a week in advance of the meetings. The appreciation of members is evidenced by the fact that railroad men and prominent scientific men interested in these subjects now offer papers or desire to present these subjects before the club so that we can announce for the whole season the subjects which are to be discussed at the regular meetings."

The paper at the October meeting was on "Heat Accumulators in Steam Engineering" by L. Battu. It applied particularly to the Rattau steam re-generator which has been the source of very great saving at points where reciprocating steam engines are in use intermittently, such as, for instance, in rolling mills, hoisting engines at mines, etc. By means of this re-generator the steam which is normally allowed to escape to the atmosphere is used to supply a low pressure turbine, which exhausts in a vacuum and drives a generator. The paper was discussed, among others, by L. R. Pomeroy, who related how heat storage had been carefully considered in connection with the problem of power plant design for the Sarnia tunnel of the Michigan Central Railway in connection with its electrification. Mr. Pomeroy presented some very interesting data in connection with heat storage. Later George A. Damon of the Arnold Company explained how the principle had been applied in practice at the above mentioned power plant. The application consisted of installing specially designed boilers, with large water and steam space, which are filled to the top of the glass before the peak of the load comes on the plant and the water level is allowed to fall during the time of overload, being filled up later as the plant runs below its capacity. The overload capacity of the generators takes care of the electrical end and in this way sufficient steam supply is obtained with boilers rated for the average daily load.

The following officers have been nominated and the ticket will be submitted to letter ballot; the result of the vote will be announced at the November meeting. President, J. F. Deems, general superintendent motive power, rolling stock and machinery, New York Central Lines; first vice-president, W. G. Besler, vice-president and general manager, Central R. R. of New Jersey; second vice-president, H. S. Hayward, superintendent of motive power, Pennsylvania R. R.; third vice-president, Frank Hedley, vice-president and general manager, Interborough Rapid Transit Co.; treasurer, R. M. Dixon, president, Safety Car Heating & Lighting Co.; executive members (three years), E. T. Campbell, purchasing agent, Erie R. R.; (one year) G. H. Campbell, general superintendent, Baltimore & Ohio; member of finance committee for three years, B. A. Hegeman, Jr., president, United States Metal & Mfg. Co.

Secretary, Harry D. Vought, 95 Liberty street, New York City.

Northern Railway Club (Duluth, Minn.).—Next meeting, Tuesday, November 24. N. P. White, roundhouse foreman of the Northern Pacific Railway at Duluth, will read a paper on "Engine Repairs in the Roundhouse from the Standpoint of a Machinist." The same subject, from the standpoint of a boilermaker, will be treated by Claude Richards.

At the July meeting a code of discipline for operating employees was submitted by a special committee. It was carefully discussed and at the September meeting it was adopted as recommended practice.

At the September meeting the discussion of a paper on "Brick Arches for Locomotives," presented at the June meeting by Charles Cotter, was completed. J. W. Kreitter, vice-president of the club, gave a brief report of the practice on each of nine of the northwestern roads. In summing up this investigation and the discussion which had taken place at the two meetings of the club he spoke as follows:

"In good water localities, the brick arch is an economy. In bad water localities, it is not."

"The arch flue should not be used, for while it might be used safely, with proper care, it has been shown that serious injuries and fatalities have occurred from its use. Angle irons or studs, fastened to the side sheets, should take the place of the flues.

"The use of the hollowed brick seems to be an improvement over the common brick, in addition acting as a smoke and spark consumer.

"The best results seem obtainable from the use of the brick arch in small engines.

"Mechanical members of this club should recommend to their officials an immediate experiment with several engines, with and without arches, with small and large engines. Also with com-

mon and hollowed brick, so that in the near future we may take this question up with additional practical information. With a road doing a large business, the time an engine spends in the roundhouse is of the utmost importance, so the experiments should bring out the time consumed preparing an engine, with and without brick, for a washout; time getting at flue repairs, with and without brick; time making the repairs, labor taking out and replacing the brick, cost of brick, fuel saving, etc."

At the same meeting a paper on "Locomotive Boiler Washing" was presented by C. W. Seddon, superintendent of motive power and cars of the Duluth, Missabe and Northern Railway. He directed attention to the importance of washing out locomotive boilers regularly and the necessity for both the mechanical and operating departments to co-operate in insisting that this be done. It is a serious mistake to intrust the work of washing out to "green" or unskilled and cheaply paid labor. He contrasted the cold and hot water methods of washing out and described the apparatus for washing out with hot water which is in use at the Proctor roundhouse of the road with which he is connected. In speaking of the results due to this installation he said: "We have found from the use of hot water a marked improvement in the cost of the maintenance of locomotives over the old system of using cold water; we have had less trouble from leaky tubes, cracked side sheets and broken staybolts and are firmly convinced that the installation of the hot water system is money well spent and will more than pay for itself in a year." Boiler washout report forms which must be filled in and sent to the office of the superintendent of motive power and the roundhouse foreman's record sheets were reproduced in the paper.

At the October meeting a paper on "Concrete and Steel Ore Docks vs. Wooden Docks" was presented by W. A. Clark, chief engineer of the Duluth & Iron Range Railroad.

Secretary, C. L. Kennedy, 401 West Superior street, Duluth, Minn.

Railway Club of Pittsburgh.—The subject for the next meeting, which will be held on November 27, had not yet been decided upon when our forms were closed.

Secretary, J. D. Conway, P. & L. E. R. R., Pittsburgh, Pa.

Richmond Railway Club.—Next meeting, Monday, November 9. An election of officers will be held and this meeting will also be a "Ladies' Night," at which some appropriate form of entertainment will be provided.

W. H. White, president of the Richmond, Fredericksburg & Potomac Railroad, made a most interesting address on "Self-Improvement" at the September meeting. A portion of this address, and also an editorial comment concerning it, will be found on other pages of this issue.

St. Louis Railway Club.—The next meeting will be held Friday, November 13, at which time the president of the club, John J. Baulch, superintendent of transportation of the Manufacturers' Railway, St. Louis, will read a paper.

The proceedings of the September meeting, containing the paper on "Relation of American Mining Schools to the Mineral Industry," by L. E. Young, director of the Missouri School of Mines, have been received. Mr. Young directed attention to the importance of mining in the United States and the fact that the American mining engineer stands at the head in his profession. He spoke of the broadness of the mining engineering courses and called attention to special features in mining education. The work of the mining schools in this country, especially of the Missouri School of Mines, was briefly considered. The remainder, and largest portion of the paper, was devoted to a consideration of the mining field, the place of the mining graduate in it, and some of the future problems which must be solved.

Secretary, W. B. Frauenthal, Union Station, St. Louis, Mo.

Western Railway Club.—Next meeting, Tuesday, November 17. Prof. C. H. Benjamin of Purdue University will present a paper on "The Impact of Fly Wheels and Drivers and Methods for Measuring."

At the October meeting E. W. McKenna, second vice-president of the Chicago, Milwaukee & St. Paul Railway, spoke on "A Constituency Without Representation." The railroad officials and employees of Chicago have effected an organization looking toward the better protection of the railroads, and necessarily of the railroad employees and those depending upon railroads for a living, from demagogical legislation, both national and state. A brief account of the formation of this organization will be found on another page of this issue. A similar organization of railway supply firms was recently effected in New York. George Post was made president. An extract of an address made by him will also be found on another page of this issue. The object of Mr. McKenna's talk was to further advance this movement. The constituency referred to includes those persons dependent upon the railroads and allied interests, which, roughly, constitutes about one-fifth of the population of this country.

The railroad library of the late Everitte St. John, formerly general manager of the Chicago, Rock Island & Pacific, and later vice-president and general manager of the Seaboard Air Line, has been presented to the club. It consists of 170 volumes.

At the September meeting the membership of the club was reported to be 1,508.

Secretary, J. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

Some Good Suggestions Concerning Railroad Clubs.

TO THE EDITOR:

While unquestionably the railroad clubs of the country are doing lots of valuable work, their usefulness might be increased to a great degree. The first and most important thing is to work up a greater interest. There are hundreds of men attending club meetings year in and year out who never say a word or do anything to encourage a club, except by their presence; in almost every instance they are capable of taking an active part in the meetings and in so doing would make them much more interesting and give others the benefit of their knowledge, and incidentally profit themselves.

Railroad club officers have much difficulty in securing good papers and a greater difficulty in getting them properly discussed after they have been secured. There is nothing that broadens men more than attending meetings of this sort and taking an active part in the discussion. I have always believed that the railroad clubs are capable of doing more work and better work for the railroads than either the Master Mechanics' or Master Car Builders' Associations. It is true that the M. C. B. Association is in position to enact certain laws, which could not be done by the railroad clubs; but, when it comes to the matter of improvement of railroad equipment, club work makes it easy for the members to put themselves in position to carry out their tests and experiments and accomplish greater results than either of the Associations, provided, of course, that the members take an active interest in the work.

"I have had a hobby for some years, but so far have been unsuccessful in getting anyone to ride it but myself, to the effect that the railroad clubs of the United States should appoint a joint committee on subjects, and that each club should discuss the same subject the same month that the other clubs are handling it; if you can get five or six of the best clubs discussing the same subject at the same time, with a membership of anywhere from four to six thousand, and the members as a class taking an active interest, it is safe to assume that there will be very little left of the subject which would not be thoroughly threshed out by the time the reports were all in, and I believe that were five or six of the best clubs to take up any particular subject, that the findings of the whole would be very valuable to any railroad interested in that particular subject. THE AMERICAN ENGINEER can accomplish great results if it is able through its efforts to build up a greater interest in club work and get more of the members to take an active part in it.

L. H. TURNER.

P. & L. E. R. R., Pittsburgh, Pa.

SELF-IMPROVEMENT.

The following is taken from an address before the Richmond Railroad Club by W. H. White, president of the Richmond, Fredericksburg & Potomac Railroad:

The theme is trite, but most significant—in my judgment, the most important in American life to-day. We are living under an order social and political, which puts no barrier in the pathway of any man who aspires to the high and influential places of his country; unlike some of the older governments, where custom is often tyrannous and church and state are only open to a favored few, favored rather by accident of birth than by individual qualities and attainments. We, every one of us, have before us from the cradle to the grave an open road to every distinction, private and public. In a word, there can be no contest with us for individual privilege and ample opportunity. A man is a man among men or a drone among drones, as he wills and determines. Are any of you railroad men, firemen? Then remember that one of the most efficient railroad presidents of this country was a fireman. Are any telegraph operators? Then know that quite a score of the present prominent railroad officials were telegraph operators. Are any clerks? Remember that many of the controlling men in public life to-day started as clerks, and one is a conspicuous cabinet officer at Washington, in control of the vast financial life of the government. So that it is now, gentlemen, an axiom that it is merit that makes the man, not social or political favoritism. It is individual purpose, energy and ambition which make the successful men of America. There is no need, therefore, to spend any energy in removing artificial impediments from any life-career you may select.

The one and only thing is for the man to prepare himself for his career; to be ready to embrace the fitting occasion when it comes. External and scholastic training may be of value in teaching one how to think, but it depends on the man himself whether and how he will think. This is what I understand to be self-improvement. Think for yourself, developing your brain power as you do that of your legs and arms, for reflect that the muscles of the brain wither or grow just as those of all other parts of the body. Tie your arm up in a sling and let it be idle for a month—it will in that short while grow flabby and frail. Let your brain be idle for the same time, and, like the arm, it becomes feeble and suggests decay. On the other hand, use it with regularity and a true upbuilding purpose, and, like the athlete training for the physical race, its muscles will grow strong, and what is far more to the purpose, its use and exercise will afford a far greater and more certain delight than that which any purely physical exercise can give. A mental joy is as far above a physical one as mind is above matter—as heaven is above earth.

I fancy no one will combat these views, but many will ask: "How can men improve themselves?" Each one differs so radically from the other. Tastes and temperaments enter so largely into the case. True; but fortunately the great God has given to every mind an appetite for something. He has imparted to the brain the same necessity for action as he has to everything else in nature, animate and inanimate. This appetite is there and must be gratified. The mind cannot stand still. This appetite must be appeased with good or bad food. In my judgment, the one way open to all for self-improvement is reading books that contain the garnered wisdom of the ages. The man who cultivates the reading habit is not going to cultivate vicious and deleterious habits. This opportunity is open to all. Books have come within the reach of the poorest. They are always at hand. Not always such as make you think upward, but of this class the supply is equal to every demand.

Without the slightest fear of successful contradiction I assert that the habit of reading good, thoughtful books is the unfailing road to self-culture and individual uplift and happiness. Again, it is the one habit which never fails to give the highest pleasure, the pleasure that brings lasting and helpful memories, the pleasure you can share with others, whether friends and acquaintances, or the members of your household—your wives and children. It is the one light in life that never fails, that shines in the darkest places, relieves the tedium of the sick room, and makes brighter by the higher conception not only this but the future life.

Take my word for it, gentlemen, that a good book is the best companion which a man can have. It matters not what a man's calling is, there will always be at least one hour of the twenty-four when he can enjoy his book. He can in spirit talk with it, study the motives and purposes of the author, compare the writer's views with his own, dissect it if he pleases, and fancy how he would have treated the same subject. Above all, if the opportunity is at hand talk with a friend of what you have read. As this habit of reading grows on you, it becomes the cherished delight of each day, and you approach your book with the same desire for mental exercise that you do your bed for physical rest.

Of course, much depends upon your selection of a book. But if it is fiction you desire you cannot err in selecting Scott, Thackeray, Washington Irving or Nathaniel Hawthorne. They are easily attainable and in pocket editions. If poetry, then again Scott, for his prose and poetry are perennial. They delight us in youth, middle-age, and even the chimney-corner period of life. Longfellow, Whittier, Edgar Poe, among our own poets, will afford an ample satisfaction to the most exacting. If history, then Green's "Short History of the English People," a book which contains more and better material in briefer compass than any I know. Among our own historians none can read Motley and Prescott without realizing their brilliancy and value. If all forms of literary entertainment are desired in two books, then the Bible and Shakespeare. The man who has these two at his mental call is not only the man whose silent moments are happy, but a man who is a power among men and never lonely with himself. He is a man whose brain daily undergoes conscious expansion; for remember, gentlemen, that the human mind is the part of God's creation which continues to grow after the body stops and grows feeble.

I had the pleasure of intimate acquaintance with a lawyer who knew Shakespeare and the Bible almost by heart. He literally lived in the atmosphere of these two books. His thoughts and feelings were colored by them, and I assure you he was before court and jury lofty, forcible, instructive, and, therefore, formidable.

In conclusion, I ask you to try my suggestion for a month. Get a fine book, devote an hour each day to it, and tell me at the end of that time if you have not been conscious of improving yourself. Yes, and conscious that you are better able to meet your daily duties; better able to understand and withstand some at least of the many efforts of charlatans and demagogues who trade on the supposed ignorance of the unthinking. You and all who study self-culture will gradually uplift the standard of citizenship until it attains a plane which will afford no place for those who are false teachers.

RAILROAD FUEL MEN TO ORGANIZE.—A circular letter is being issued inviting all purchasing and fuel agents, fuel supervisors, fuel accountants, and chief clerks to heads of departments handling fuel on railroads, to attend a meeting to be held in the Parlors of the Auditorium Annex Hotel, Chicago, on November 20, at 10 A. M., for the purpose of organizing an association. Such an association could properly take up and discuss the best and proper methods of handling, inspecting, weighing, distributing and accounting for fuel and oil. Those wishing to attend this meeting are requested to address Eugene McAuliffe, general fuel agent, Rock Island-Frisco Lines, La Salle Street Station, Chicago, Ill., who is chairman of the organization committee.

B. OF L. E. BUILDING.—The Brotherhood of Locomotive Engineers is to have a home of its own. Mr. W. S. Stone, grand chief, has announced that it has been decided to erect a building in Cleveland, Ohio, for a home office, the building, equipment, etc., to cost about a million dollars. It is to be twelve stories high and modernly equipped throughout, besides having a large auditorium with a seating capacity of about 1,600 or 1,800. This organization now has a membership of over 63,000.

COMBINED SIMPLE AND COMPOUND LOCOMOTIVE.

COMPARATIVE TRIALS OF SIMPLE AND COMPOUND LOCOMOTIVES.

GREAT NORTHERN RAILWAY (ENGLAND).

In 1906, Mr. Henry A. Ivatt, locomotive superintendent of the Great Northern Railway of England, carried on a most carefully conducted series of trials, in regular service, of three locomotives which were entirely comparable in every respect, except the arrangement of cylinders and the steam distribution. The results of these trials was reported before the Institution of Mechanical Engineers by Mr. Ivatt and are given later in this account.

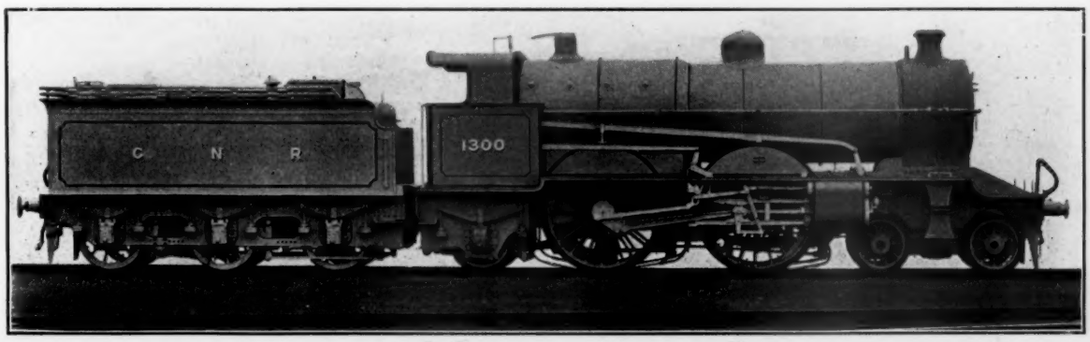
We have been fortunate in obtaining from Mr. O. V. P. Bulleid, assistant works manager of the locomotive department of the Great Northern Railway at Doncaster, some general drawings and information concerning the design of the locomotives under trial which permits the results of the trials to be much better appraised.

Of the three locomotives tested No. 1300 is four cylinder balanced compound Atlantic type, having a narrow fire box, built by the Vulcan Foundry Co. No. 292 is a four-cylinder combined compound or simple Atlantic type locomotive with a wide fire box, which was designed and built by the Great Northern Railway, as was also No. 294, which is a two-cylinder simple Atlantic type with a wide fire box. All of these engines, as will be seen by reference to the table of dimensions, are practically equal in weight and power and permit a fair comparison to be obtained between simple and compound working.

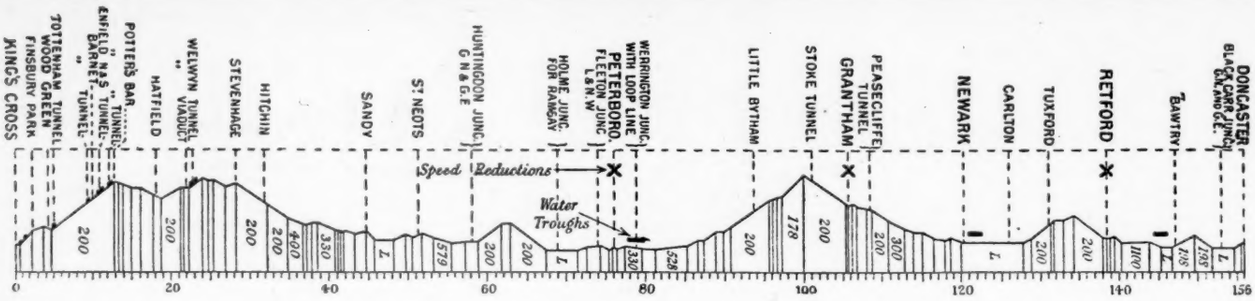
Locomotive No. 1300 is a compound of the DeGlehn type with cylinders 14 and 23 x 26 in., having piston valves on the high and slide valves on the low pressure cylinders. The high pressure cylinders on the outside of the frames connect with the rear driving wheels and the low pressure, placed just below the smoke box between the frames, connect with the cranked axle of the front pair of drivers. The steam pipe passes down inside of the front end and emerges just underneath the barrel of the boiler and between the frames, being continued by a

SIMPLE ATLANTIC TYPE LOCOMOTIVE.

curved pipe to the high pressure steam chest. The locomotive is fitted with a variable exhaust nozzle and with gridiron type of throttle valve. Each wheel has its own individual spring rigging and the weight is not equalized between the different wheels. In this respect the three locomotives are alike. The fire box gives 31 sq. ft. of grate area, setting between the plate frames and having a very deep throat. The boiler tubes are of the Serve type with 7 ribs. They are 2¾ in. diameter and are set with 1 in. bridges. The tubes occupy 31 per cent. of the barrel at the smoke box end. The general dimensions of the locomotive are given in the accompanying table. From these



DEGLEHN COMPOUND LOCOMOTIVE.



PROFILE OF ROAD OVER WHICH TEST WAS MADE.

and reference to the description of a similar locomotive built for the Paris-Orleans Railway by the American Locomotive Company, given elsewhere in this and the September issue of this journal, a good idea of the construction of No. 1300 will be obtained.

Locomotive No. 294 is a simple engine built at Doncaster, which has the dimensions given in the accompanying table. With the exception of the cylinders and their attachments, this locomotive does not differ in any essential feature from No. 292, the details of which are illustrated herewith.

Locomotive No. 292 is of the balanced compound type, but of new and very novel construction, as will be seen by reference to the accompanying drawings. All four cylinders are located below the smoke box with the high pressure outside and the low pressure between the frames. The high pressure cylinders, which are 13 in. in diameter and have a stroke of 20 in., connect by means of a 10 ft. connecting rod to the rear pair of drivers. The low pressure, or inside cylinders, which are 16 x 26 in., connect to the cranked axle of the forward pair of drivers, having connecting rods but 4 ft. 8 in. in length. Each cylinder has its independent valve gear, the outside gear being of the Walschaert type and the inside of the Stephenson design. Slide valves are used throughout, those for the low pressure being set vertically between the two cylinders.

A manually operated intercepting valve, which is shown in section in the longitudinal section of the locomotive, is provided, which permits the continuous operation of the locomotive as either a four-cylinder simple or a four-cylinder compound. This valve simply changes the connection between ports, so that in simple working, a passage is opened for steam at boiler pressure to pass through the connection in the front end to the opposite low pressure steam chest while the exhaust of the high pressure steam is permitted to go to the stack. For compound working this valve is shifted and cuts off the high pressure steam passage and sends the exhaust from the high pressure cylinder through the pipe to the low pressure cylinder on the opposite side. These pipes in the front are of the same length and act somewhat as reheaters for the steam going to the low pressure cylinder. Although the two cylinders do not differ greatly in diameter they have a volume ratio of nearly 1 to 2.

These locomotives have the smallest possible rigid wheel base, 82 in., the flanges of the driving wheels just clearing when new. The trailing truck consists simply of outside journal boxes having ½ in. side play in the pedestals on the supplementary trailing frame.

The spring rigging of this locomotive is interesting and contains no system of equalizers. The front drivers have semi-elliptical springs, while the back pair of drivers have helical springs. The engine truck has helical springs, while the trailing truck has elliptical springs over the outside journals. Auxiliary rubber cushions are used throughout and will be noticed at the bottom of the spring hangers.

The boiler is of the straight type, measuring 64½ in. outside diameter at the front end. The inner fire box is copper and the iron tubes have copper ends brazed on for connection at the flue sheet. The tubes have a rise of 2 in. toward the smoke box end and are expanded at both ends. They have steel ferrules for protection at the fire box end. The fire box is fitted with a

GENERAL DIMENSIONS OF LOCOMOTIVES TESTED.

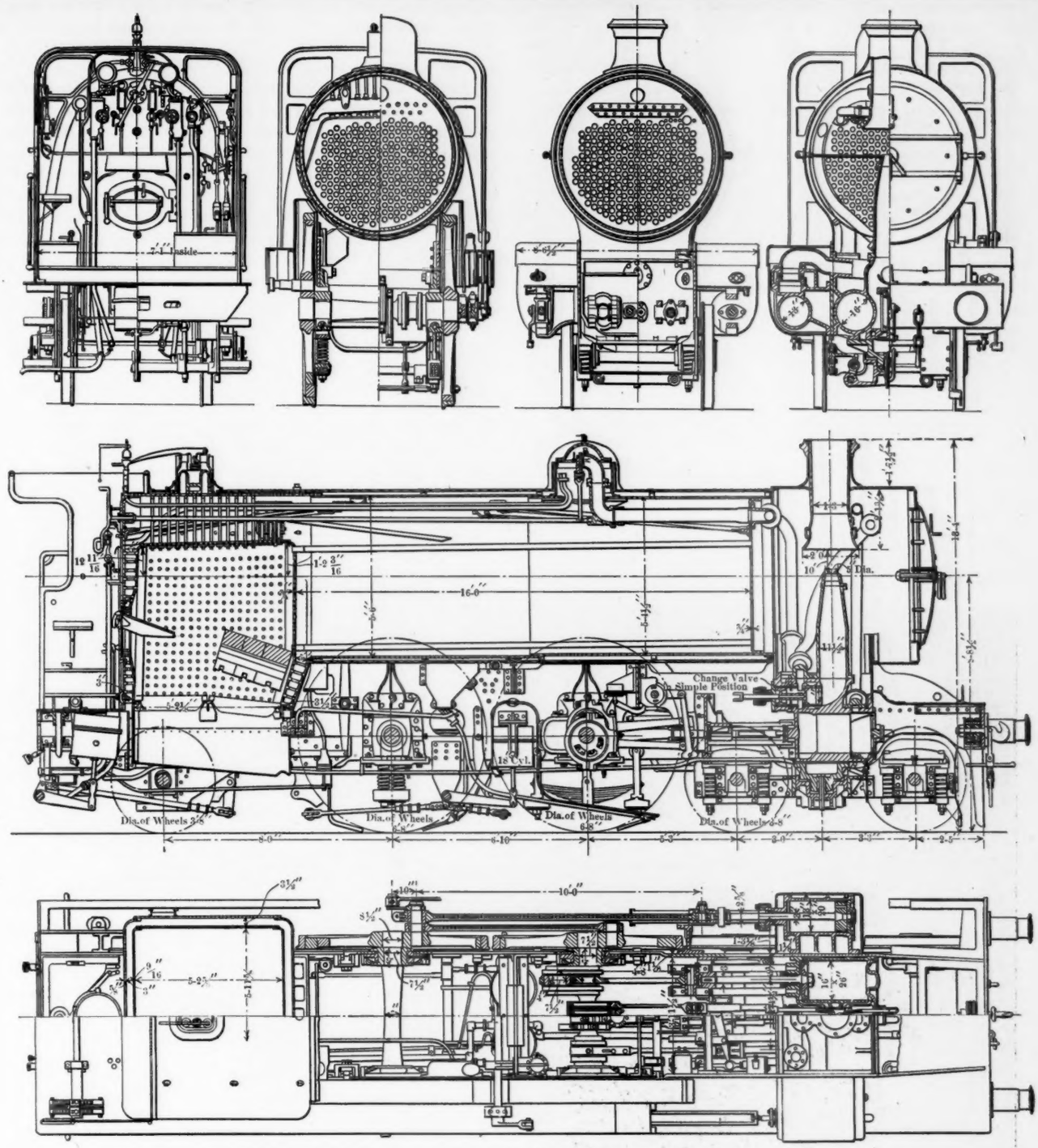
Locomotive Number	1,300	292	294
Tractive effort*, lbs.	14,869	8,994	16,875
Tract. effort, 292 as simple, lbs.	.....	20,070	.....
Weight in working order, lbs.	159,040	153,440	152,990
Weight on drivers, lbs.	82,880	80,640	80,640
Weight of engine and tender in working order, lbs.	250,660	245,060	244,610
Wheel base, driving	8 ft. 6 in.	6 ft. 10 in.	6 ft. 10 in.
Wheel base, total	28 ft. 3 in.	26 ft. 4 in.	26 ft. 4 in.
Wheel base, engine and tender	49 ft. 6 in.	48 ft. 5½ in.	48 ft. 5½ in.
RATIOS.			
Cylinders	2.7	1.96	.....
Weight on drivers ÷ tractive effort (292 comp.)	5.5	8.96	4.78
Total weight ÷ tractive effort (292 comp.)	10.69	17.06	9.07
Tractive effort x diam. drivers ÷ heating surface	473.	287.8	540.
Total heating surface ÷ grate area	81.1	80.64	80.64
Tube heating surface ÷ firebox heating surface	13.79	16.73	16.73
Weight on drivers ÷ total heating surface	32.96	32.26	32.26
Total weight ÷ total heating surface	63.26	61.38	61.2
Volume both cylinders, cu. ft.	17.14	9.12	7.67
T'l heat. surf. ÷ vol. cylinders	146.6	274.12	325.94
Grate area ÷ vol. cylinders	1.8	3.39	4.04
CYLINDERS.			
Number	4	4	2
Kind	Compound.	Comp. or Simp.	Simple.
Diameter and stroke, inches.	14 & 23 x 26	13 & 16 x 20 & 26	18¾ x 24
VALVES.			
Kind, H. P.	Piston.	Bal. Slide.	Bal. Slide.
Kind, L. P.	Bal. Slide.	Bal. Slide.	.....
Greatest travel, inches	5¾	4⅜	4½
Outside lap, H. P., inches	⅞	1	1 3/16
Outside, lap, L. P., inches	⅞	15/16	.....
Inside clearance, inches	.....	⅛	⅛
Lead in full gear, H.P., inches.	¼	⅛	1/16
Lead in full gear, L.P., inches.	¼	1/16	.....
WHEELS.			
Driving, diam. over tires, inches	80	80	80
Driving journals, main, diameter and length, inches	8½ x 9	7½ x 7	8½ x 9
Engine truck wheels, diam., in.	38	44	44
Engine truck, journals, in.	5¾ x 9	5¾ x 9	5¾ x 9
Trailing truck wheels, diam., in.	44	44	44
Trailing truck, journals, in.	5½ x 10	5½ x 10	5½ x 10
BOILER.			
Working pressure, lbs.	200	200	200
Outside diam. of 1st ring, in.	63	66	66
Firebox, length and width, in.	120x48½	71x81	71x81
Firebox plate, thickness, in.	⅝	9/16	9/16
Firebox, water space, in.	3 & 3½	3 & 3½	3 & 3½
Tubes, number and outside diameter, in.	149-2¼	248-2¼	248-2¼
Tubes, length	12 ft. 4 in	16 ft.	16 ft.
Heating surface tubes, sq. ft.	2344	2359	2359
Heating surface firebox, sq. ft.	170	141	141
Heating surface, total, sq. ft.	2514	2500	2500
Grate area, sq. ft.	31	31	31

* For Simple..... $T.P. = \frac{0.8\ P\ d_h^2\ s_h}{D}$

For Compound..... $T.P. = \frac{1.6\ P\ d\ s_l}{D\ (r+1)}$

For No. 292 working Simple $T.P. = \frac{0.8\ F}{D}\ (d_h^2 \times s_h + d_l^2 \times s_l)$

Where D = Diameter of Driving Wheel, inches.
d_h = Do. High Pressure Cylinder, inches.
d = Do. Low Pressure Do. Do.
P = Boiler Pressure in lbs. per square inch.
s_h = Stroke of High Pressure Cylinder, inches.
s = Do Low Pressure Do. Do.
r = Ratio of Cylinder Volumes.



SECTIONS OF COMBINED COMPOUND AND SIMPLE LOCOMOTIVE—GREAT NORTHERN RAILWAY (ENGLAND).

brick arch and in addition a steel deflector is arranged over the fire door. The grates are in two sections, and are of the stationary type. In the front end the inside stack, or cowl, as it is called abroad, has an annular passage near the bottom, with a large number of ½ in. holes projecting upward toward the top of the stack. This is arranged for the exhaust of the steam ejector of the vacuum brake.

An inspection of the illustrations will reveal other interesting features of this design, which in many ways represent a very decided departure from standard practice as known in this country.

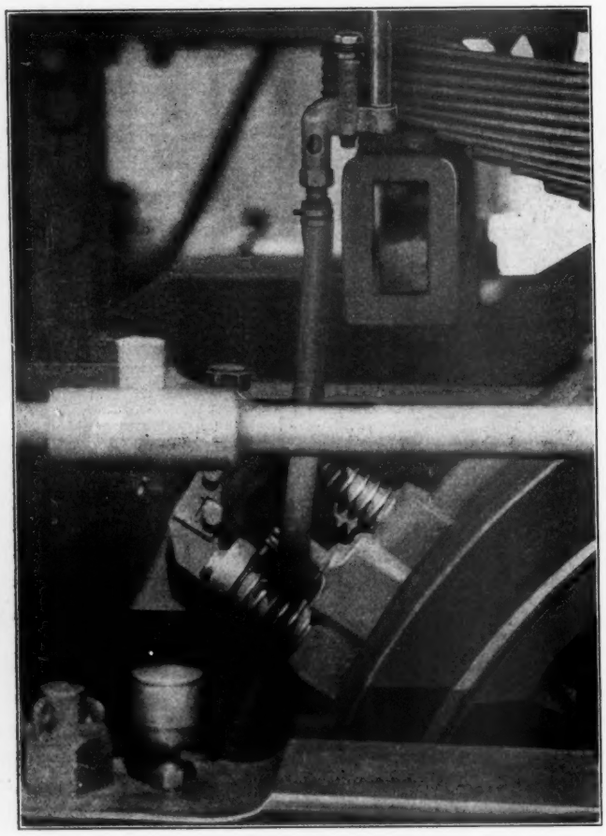
TRIALS.—The tests or trials of these locomotives were made for the purpose of determining the saving, if any, that could be obtained by the use of the compound locomotive in actual every-day practice, covering a long period of time. The trials took place between London and Doncaster, a profile of which line is shown in one of the illustrations. They were so arranged that each engineer and fireman of the three sets of men selected should run each engine for three weeks, with the same group of trains (mostly express), in regular rotation. In this way each engineer made the same number of trips with each engine on each train and the personal equation was practically eliminated. The crew ran each engine for one week prior to beginning the three weeks' trial, in order to get perfectly familiar with them.

The engines were put into the same condition of repair before the trials and were treated in the same way throughout. They were supplied with exactly the same quality of coal and an inspector on each engine throughout the trials took careful account of the coal and water, time lost or made up, condition of the weather, weight and composition of the trains and the cost of running repairs. The results of these trials are given in the following table, which was presented before the Institution of Mechanical Engineers:

	Engine No. 1300.	Engine No. 292.	Engine No. 294.
Miles run, Engine	11,286	11,670	11,673
Miles run, Train	11.045	11,415	11,415
Speed, Average miles per hour.	49.2	49.9	49.58
Weight of Train, Average tons.	229.98	238.03	234.29
Ton Miles:—			
Total Train	2,540,130	2,717,112.5	2,674,420
Including Engine and Tender.	3,803,030	3,993,812	3,949,110
Per hour, Engine and Tender.	16,759	17,337	17,030
Coal Used:—			
Per engine-mile, lbs.	44.86	43.02	44.31
Per train-mile, lbs.	45.84	43.98	45.31
Per ton-mile, lbs.	0.133	0.126	0.131
Oil Used:—			
Per 100 engine miles, pints.	7.34	7.18	6.22
Per 100 ton-miles, pints.	0.022	0.021	0.0184
Costs:—			
Coal—			
Per engine-mile, pence.	2.4	2.3	2.37
Per ton-mile, pence.	0.0071	0.0067	0.007
Oil:—			
Per engine-mile, pence.	0.165	0.16	0.14
Per ton-mile, pence.	0.00049	0.00047	0.00041
Repairs:—			
Per engine-mile, pence.	0.56	0.45	0.37
Per ton-mile, pence.	0.0017	0.0013	0.0011
Total:—			
Per engine-mile, pence.	3.125	2.91	2.88
Per ton-mile, pence.	0.0092	0.0085	0.0085

LOCOMOTIVE WHEEL FLANGE LUBRICATOR.

Because of the numerous sharp curves on certain divisions of practically all the railroads in the country, an excessive amount of trouble is caused by worn flanges of locomotive driving and truck wheels. Incidentally an excessive amount of wear is also given to the rails, compelling their frequent renewal. It is easy to understand that if the inner part of the flange of the wheel or



DRIVING WHEEL FLANGE LUBRICATOR.

the inside face of the rail could be properly lubricated a very large proportion of this wear would be eliminated.

A lubricator for exactly this purpose has been designed and is being manufactured by the J. C. Martin Sons Co., San Francisco, Cal., which is shown, as applied to a locomotive driving wheel, in the accompanying illustration. This device has proved to be capable of remarkable results in actual service and is in use on quite a number of railroads of the Southwest and in Mexico. It has been found to be particularly valuable when applied to the trailing wheels of Pacific type locomotives.

The arrangement consists of a shoe which fits over the flange, being held in place by a couple of coiled springs and guided by a yoke attached to the frame. Provision is made for accommodating the movement of the wheel by allowance between the guide yoke and the guides, as well as by the compression of the springs. The interior of the shoe is hollow, the open section extending from the top to the throat of the flange and being filled with an absorbent material, which thus lubricates simply the bearing surface of the flange. Crude oil has been found to work the best and the supply is kept in a tank in the cab, being fed to the shoe by gravity, there being a sight feed valve convenient to the engineer, or fireman, which, when once properly set, requires no further attention.

Comparative tests have shown a reduction of 60 per cent. in the wear on driving wheel flanges by the use of this lubricator.

Bureau of American Manufacturers in Europe.—A bureau bearing the above name has recently been organized and is open to all reputable American firms. It has leased a six-story building in the business center of London where visiting buyers can always see an exhibition of American goods. A monthly bulletin is to be sent out to buyers in every quarter of the globe and personal letters will be distributed to them at frequent intervals. In fact, every mode of advertising consistent with progressive business methods will be employed to make the exhibit a profitable enterprise to the members. A staff of experienced salesmen will be engaged who will be specially trained in the lines to be demonstrated and buyers will be served as carefully and thoroughly as would be possible in the home offices of the respective members. Those interested in this movement can obtain full information by addressing Pitt & Scott, Ltd., 35 Broadway, New York.

The Flat Cars from which spoil is plowed on the Lidgerwood system of the Panama Canal are now being provided with a side extension which practically carries the floor about 15 in. over the side on which the spoil is dumped. According to the *Canal Record* experience shows that this extension enables the cars to be loaded more heavily and also dumps the material farther away from the trucks. Another improvement made in such cars is the use of a hinge and support which brings the aprons that connect two cars below the level of the floor, thus doing away with the trouble formerly experienced in having the aprons torn off by the plows.

Nine-Horse-Power Gasoline Engine vs. Two 50-Horse-Power Electric Motors.—The Big Four Railroad has recently completed a Scherzer rolling lift bridge across the Cuyahoga River at Cleveland, O. This is a double track structure, the lifting span, located about 70 feet above the water level, being about 160 feet long and crossing the river at an angle of 62 degs. The bridge is operated by two direct current electric motors of 50 h.p. each. For emergency work, in case of trouble with the electrical equipment or current, there has been installed a 9 h.p. Fairbanks-Morse gasoline engine, which will lift the bridge in twelve minutes, doing the work of the two 50-h.p. motors.

A Gasolene Motor of Unusual Lightness has recently been built by the Adams Co., Dubuque, Ia., for airship purposes, the complete engine, a five-cylinder 36-h.p. motor, weighing but 2.7 lb. per horse-power of its capacity. It utilizes the Adams-Farwell revolving-cylinder gyroscopic motor construction, the five cylinders revolving around a single-throw crank-shaft, which renders a flywheel unnecessary and so facilitates the cooling of the cylinders that air cooling flanges are not needed.

Master Mechanic Scholarships.—The scholarships which the American Railway Master Mechanics' Association maintains at Stevens Institute of Technology were this year awarded to the following men in the entering class: Mr. R. T. Branch, of Brooklyn; Mr. G. L. Clouser, of Jersey City, and Mr. L. B. Paterson, of Cranford, N. J.

A NEW 4 FOOT RADIAL DRILL.

A number of interesting features and improvements have been introduced in the new radial drills built by the Dreses Machine Tool Co., Cincinnati, O. These drills are based on the previous designs of this company and many of the older time-proven features have been retained.

The accompanying illustrations show the construction of several parts of the 4-foot drill very clearly. The double column is interesting and is shown in Fig. 2. The inner column is stationary and the outer shell turns on roller bearings. These bearings have small and large rollers alternating so that there is no slipping friction between the load carrying rollers. It will also be noted that the clamping band grips the inner and outer column, but exerts no pressure on the bearing.

The spindle sleeve is made of bar steel and the bearings are lined with phosphor bronze bushings. The rack is cut directly on the sleeve, which not only allows a perfectly round hole to be bored and reamed in the head stock for the sleeve, a great advantage in itself, but also brings the pressure on the rack closer to the center of the spindle.

There are four changes of feed, which are operated by a small handle shown on the worm shaft. The feed is of the all-geared type, but a frictional connection is interposed which yields just before the breaking point of the weakest gear. The lever, shown just below the arm, starts, stops or reverses the spindle by means of the friction clutch. The back gears are on the rear of the head stock and can be engaged or disengaged while the machine is running.

The speed variator is so arranged that the machine is always running at the slowest speed when speed changes are being made, thus preventing the sudden change in momentum which would follow starting from a stopped condition. In this speed variator, a section of which is shown in Fig. 3, a new overrunning clutch has been introduced, which is shown in detail in Fig. 4. The gear, B, runs loose on the variable speed shaft and is internally clutched by four pawls, P, located in the fixed gear, C. These pawls are kept in contact with the gear by means of the spiral springs, S, and by limiting their faces to 5/16 in. of circumferential width they will clutch the gear, B, to gear, C, when running in the direction of the arrow, but will release when C runs faster than B.

All of the high speed bearings in the machine are lined with removable phosphor bronze bushings and all of the bevel gears

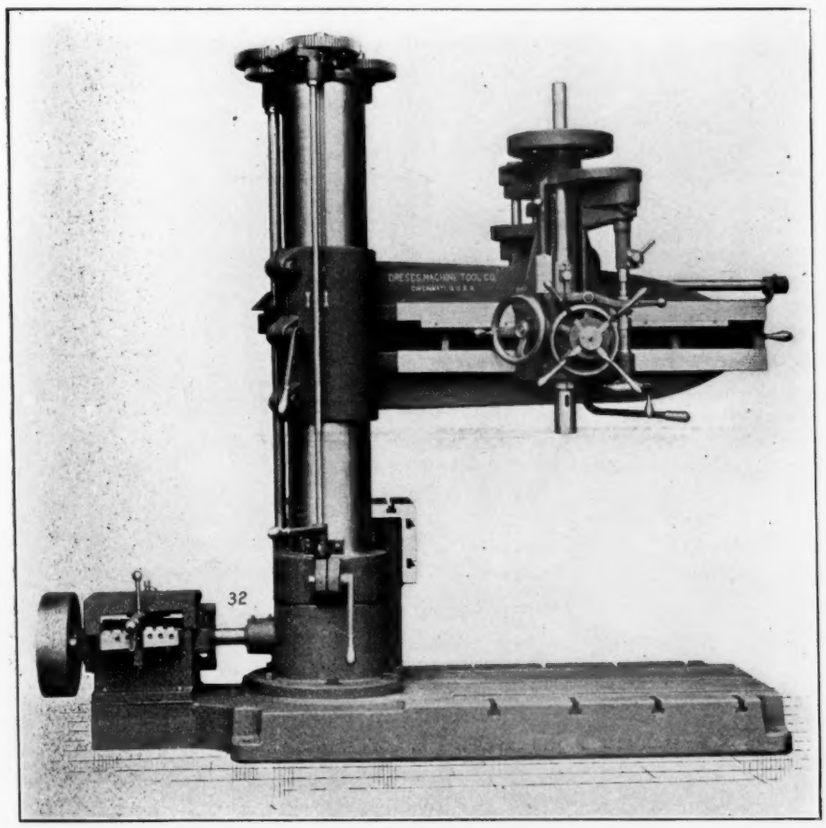


FIG. 1.—NEW FOUR-FOOT RADIAL DRILL.

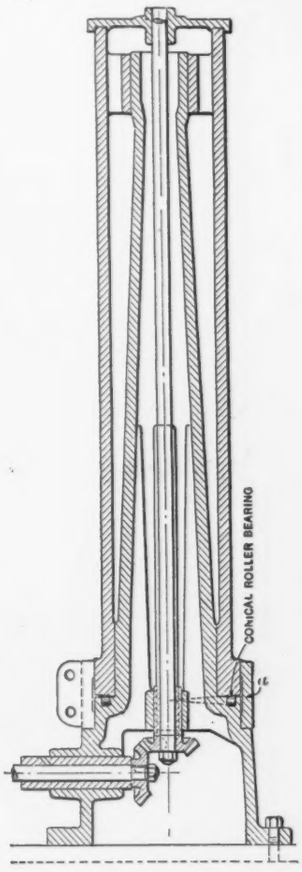


FIG. 2.—DETAIL OF COLUMN.

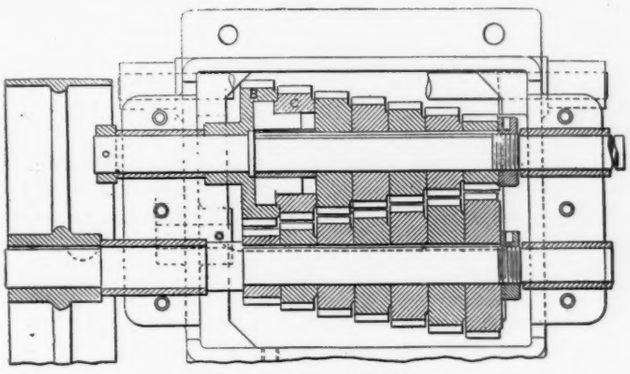


FIG. 3.—SPEED VARIATOR.

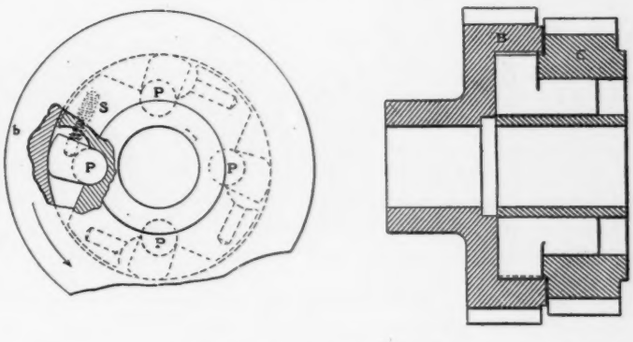


FIG. 4.—OVERRUNNING CLUTCH.

and pinions below 6 in. are of bar or forged steel. The elevating device of the arm is so designed that the gears are stopped when not in use. The arm itself is of box parabolic shape, the lower rib being double webbed to give the greatest resistance to bending and torsional strains. All of the gears which could possibly be dangerous to the operator have been encased.

ELECTRICITY INCREASES TRAFFIC CAPACITY.—"The greatest value to be experienced by electrification will be in the tremendously increased traffic capacity of the present track mileages, due to the facility electricity offers in making rapid main line and yard train movement, or, stated in another way, it is thus immediately seen that electrification will permit a tremendous increase of traffic without an increase of traffic mileage, and thus roads which are up against the requirement of handling their congested traffic by laying new tracks, which, of course, is a most expensive procedure on account of right-of-way difficulties, will be led into providing an equal capacity by electrification of the old trackage."—*W. S. Murray, N. Y., N. H. & H. R. R.*

MONORAIL ELECTRIC RAILROAD.—The Monoroad Construction Company has purchased from the Interborough Rapid Transit Company of New York, the Pelham Park and City Island Railroad, which is about three miles in length and is at present operated by horses. It is proposed to convert this line to the Monorail system on which 50 ft. cars, pointed at each end and supported by four wheels having flanges on each side placed in tandem at either end, and guided by two overhead rails supported from a catenary system of suspension, will be operated.

C. P. R. STRIKE ENDED.—Press despatches of October 6 report the strike of shop employees on the Canadian Pacific Ry., which began the first week in August, as settled. The strikers returned to work on the conditions that existed before the strike and the company announces that the new men will not be discharged, except for inefficiency.

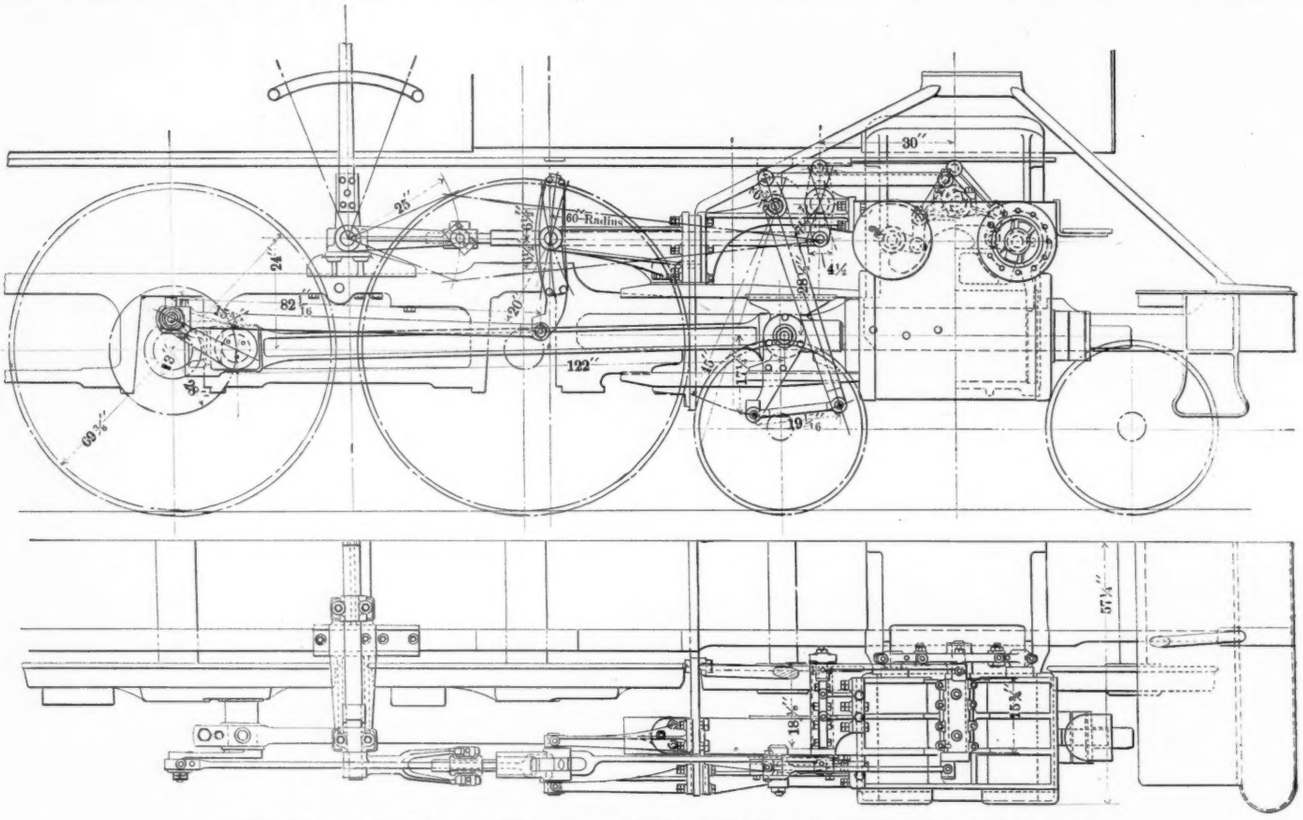
The law of New York State, requiring railroad companies to pay their employees semi-monthly, went into effect October 1.

NEW DESIGN OF YOUNG VALVE AND GEAR

DELAWARE, LACKAWANNA & WESTERN RAILROAD.

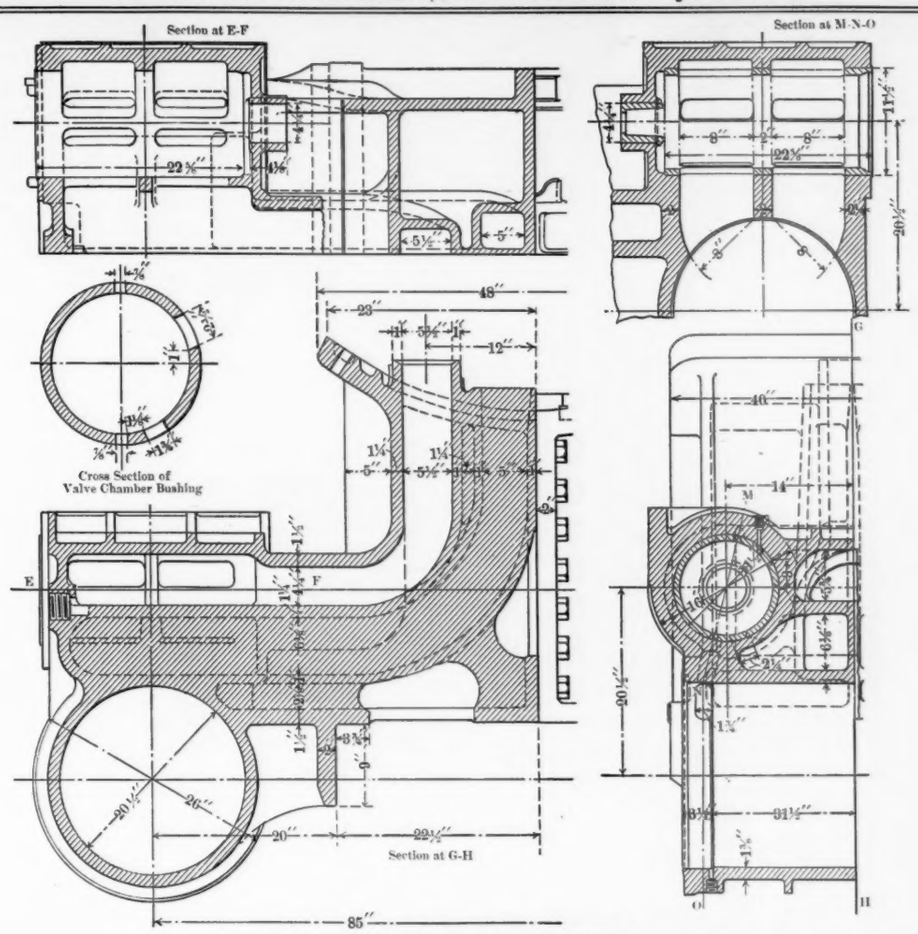
On page 65 of the February, 1906, issue of this journal appeared a very completely illustrated description of the Young valve and gear as applied to a 10-wheel locomotive on the Delaware & Hudson Railroad, the application being made in connection with the Stephenson type of valve gear. Recently a new design, using the same type of valve, with an entire alteration in the valve gear, which closely resembles the Walschaert type, has been applied to some locomotives on the Delaware, Lackawanna & Western Railroad, and is also being fitted to some locomotives of the Chicago & Northwestern Railroad now under construction. The former application is shown in the accompanying illustrations.

Briefly, this type of valve gear employs two rotary valves on



YOUNG VALVE AND GEAR AS APPLIED TO DELAWARE, LACKAWANNA & WESTERN R. R. LOCOMOTIVE.

each side of the locomotive, located above and with their axes at right angles to the axis of the cylinder. These valves are operated simultaneously from a wrist plate, which receives its oscillating motion from a connection to the eccentric or return crank through the medium of the link, by means of which reversing, the point of cut-off and other valve events are controlled in the usual manner. The fulcrum of this wrist plate is formed on one end of a bell crank, which, in a case of application with the Stephenson valve gear, was altered in position by a connection to the reverse shaft, but did not change its position except as the reverse lever and hence the cut-off was altered. In the latter design, however, this bell crank is operated from a combination lever connected to the cross head and having a stationary fulcrum, with the result that the position of the wrist plate fulcrum is constantly being changed at different points of the stroke and gives a material alteration of the point of occurrence of the steam events in the cylinder from what is usually obtained with the ordinary design of Stephenson or Walschaert valve gear. The effect of this combination of motions is that the valves have a constant lead for all points of cut-off, the early release of the Stephenson and Walschaert gear is maintained, but the point of exhaust closure is materially delayed and the opening of the valve ports during exhaust is very decidedly increased. The construction of the valve and steam passages is



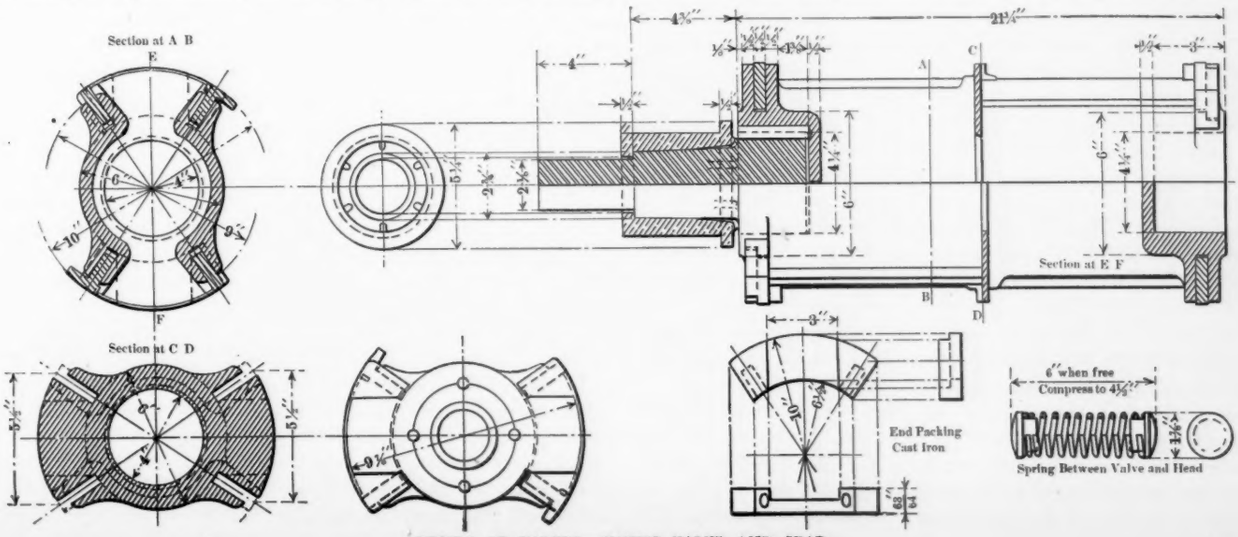
CYLINDERS FOR YOUNG VALVE AND GEAR.

such as to give a largely increased port opening, the port being equivalent to one 32 in. in length on a slide valve, which, taken in connection with the rapid movement of the valve at the point of cut-off, gives a very free admission and permits the pressure to be held up to the point of cut-off even at very high speeds. The principal gain, however, as relates to both speed and economy is in the much larger port openings for exhaust, particularly at the middle of the stroke when the piston is moving at its highest speed.

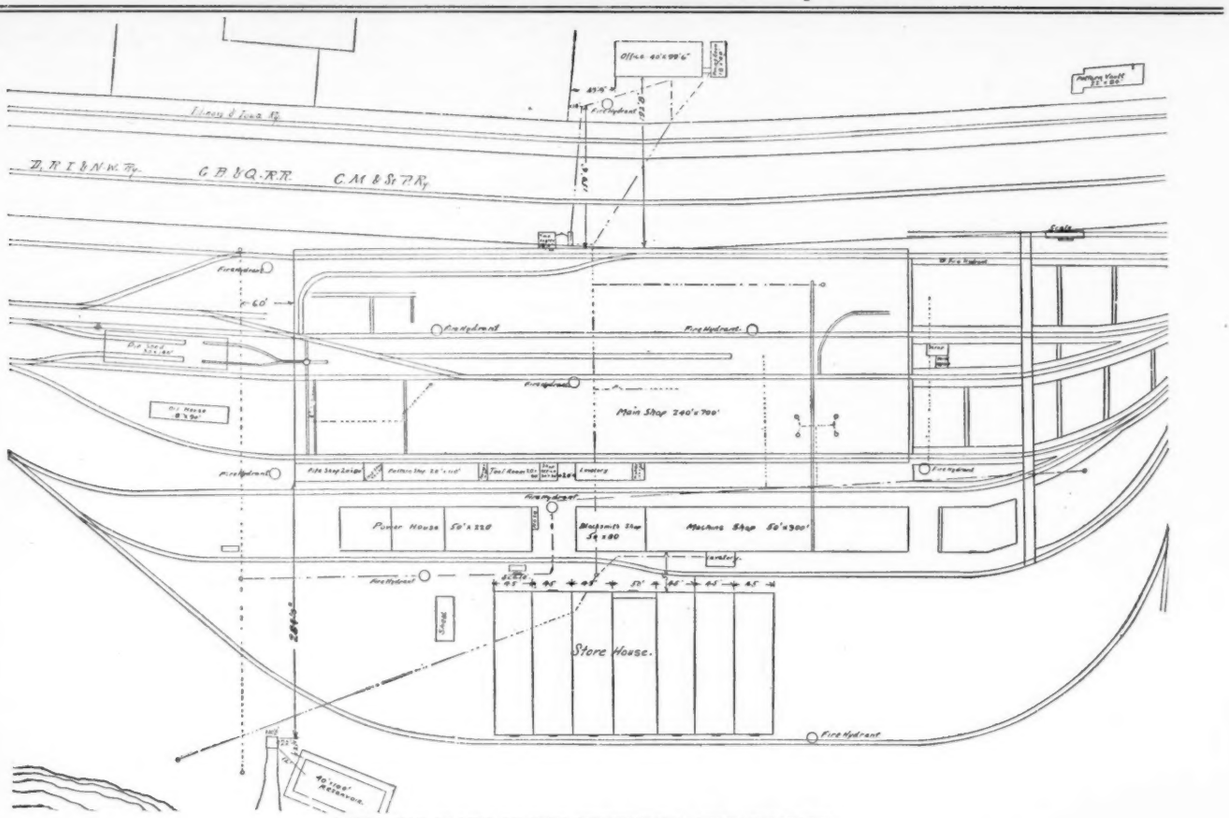
The construction of the cylinders and valves and arrangement of the gear, is clearly shown in the accompanying illustrations. It will be seen that the valve chambers are formed as part of the cylinder casting, the location being such as to give a very short and direct steam port from the bottom of the chamber, there also being a supplementary steam passage from the top of the valve chamber. The valves are 1 in. in diameter and 21¼ in. total length, and have been simplified somewhat over those used on the Delaware & Hudson locomotive above referred to. The valve, of course, is made as light as possible and its weight is carried by the bearings at either end, with the result that there is practically no wear on the bushings.

The valve gear in appearance is very similar to the ordinary Walschaert type, but differs from it, first, by having the combination lever arranged with a fixed fulcrum and by connecting the radius bar to a rocker, which transposes the motion from the plane of the return crank to the inside of the valve chambers, where the wrist plate and bell crank are located.

The application of this gear to the Chicago & Northwestern locomotives is an excellent testimonial of its value, since it was on this road, in 1903, that the first gear was put in operation.



DETAILS OF VALVES—YOUNG VALVE AND GEAR.



STEEL CAR PLANT OF THE BETTENDORF AXLE COMPANY.

A MODERN STEEL CAR PLANT.

The shops of the Bettendorf Axle Company, which is engaged in the manufacture of car equipment and the building of all-steel cars, have been very materially enlarged in the past few years to enable the company to handle its growing business. The new site at Bettendorf, a suburb of Davenport, Iowa, covers an area of 70 acres which are rapidly being utilized for manufacturing purposes. The layout, shown herewith, gives the arrangement of buildings and the excellent railroad connections which facilitate the operation of this plant.

The main shop of the plant, a building 700 x 240 feet in size, contains perhaps the most complete hydraulic plant in the country. All, or nearly all, of the shaping of the car parts is accomplished by the aid of hydraulic presses, of which there are upwards of sixty, varying in capacity from fifty to eighteen hundred tons. Some idea of the power developed can be gained when it is stated that in the largest of these presses 34-inch I-beams are shaped cold, *i. e.*, the ends are reduced and the beam is otherwise shaped and punched in various places without being heated; and all the smaller car parts, except the castings, are shaped and prepared for use in the same way. All special hydraulic machinery, used in this plant, was designed and built by the company.

Aside from the complete hydraulic plant, and in connection therewith, the works contain a full complement of other machinery operated by electric power and compressed air. There are eleven traveling cranes of varying capacity, which are electrically operated and enable the rapid assembling of the car parts. They were furnished mainly by the Pawling & Harnischfeger Company and the Cleveland Crane Company.

Much of the riveting (of sheets particularly) is done by compressed air, and this power is also made use of in finishing most of the car parts. A sand-blasting apparatus for cleaning the sheets and other parts of car, preparatory to painting, has been installed and is also operated by compressed air. A complete electric light plant furnishes light for the shops as well as for the office building some little distance away.

The operation of the main shop is from east to west. The hydraulic presses are located in the east end where the bolster and car parts are shaped and punched. The car and bolster riveting departments are in the west end of the shop. The castings are brought from the storehouse, south of the main shop, into the center of the shop where they are riveted to the steel bolster and car parts. The body and truck bolsters, steel underframes and all-steel cars are assembled, painted and shipped from the west end.

Immediately south of the main shop is the power house, 80 x 220 feet in size, part of which until recently was utilized as a machine shop. The six horizontal boilers, with an aggregate capacity of about 1,000 h.p., are in the west end of the building, and the engine room adjoining contains the pumps and machinery.

Still further to the south and east are the extensive store houses for the material, covering an area of several acres, and to the west is the paint shop and other minor buildings in a group by themselves. The D. R. I. & N. W. Ry., C. M. & St. P. Ry. and the C. B. & Q. Ry. run through the manufacturing tract, and excellent switching and yard facilities, including four tracks, running through the main buildings, have been obtained. Locomotive cranes facilitate the loading and unloading of materials in the yards and shops.

The machine shop, as has been stated, was until recently located in the power building, but the available space proving entirely inadequate for the purpose, it was last fall decided to erect a new machine shop directly east of the power house and south of the main shops. The new machine shop is a building 50 x 380 feet in size, of which the west 80 feet will be utilized for the blacksmith shop, leaving the size of the machine shop proper 50 x 300 feet.

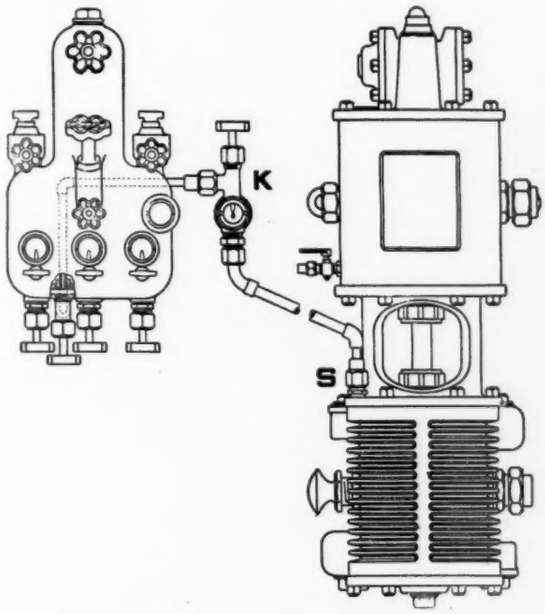
The office building of the company has also recently been enlarged by the addition of a second story, which will give more room for the clerical force.

To give an idea of the progress made by the Bettendorf company in the manufacture of railway equipment, it may be stated that starting in about ten years ago with the production of the I-beam bolsters in the old Davenport plant, there has since been added the manufacture of the Bettendorf steel car underframe, the cast steel truck with integral journal boxes, and finally complete tank and freight cars. The capacity of the present plant is 25 complete cars or forty steel underframes in a day.

SIGHT FEED AIR CYLINDER LUBRICATOR.

For the purpose of securing proper lubrication of the air cylinders of locomotive air pumps the Detroit Lubricator Company has designed a sight feed lubricator attachment which gives the engineer complete and convenient control of the lubrication of his pump. It consists of three parts: first, the emergency valve, which takes the place of the plug in the bottom of a Detroit lubricator. Next comes the sight feed fitting, which is equipped with regular bull's-eye glasses and can be located at any convenient point in the boiler head within reach of the engineer. The third fitting is a check valve connection, which takes the place of the present oil cup on the air cylinder and is provided with a ball check seating upwards, and prevents the compressed air from entering the oil delivery pipe. The illustration shows the arrangement and connections for these fittings.

The location of the sight feed fitting should be such as to give a gradual incline to the pipe leading to the check valve, so that the oil can flow by gravity to the pump. There must, however,



be a trap between the lubricator and sight feed fitting to prevent the water from entering the supply pipe after all the oil has been fed from the reservoir. To provide for this the oil supply pipe is extended upward from the emergency valve to about the same height as the upper part of the oil reservoir.

Provision is made for a double sight feed fitting for use with compound or duplex pumps. The makers of this device do not advise a constant feed of oil to the cylinders, but recommend that not more than ten drops of oil be fed at any one time and these at intervals, according to the judgment of the engineer.

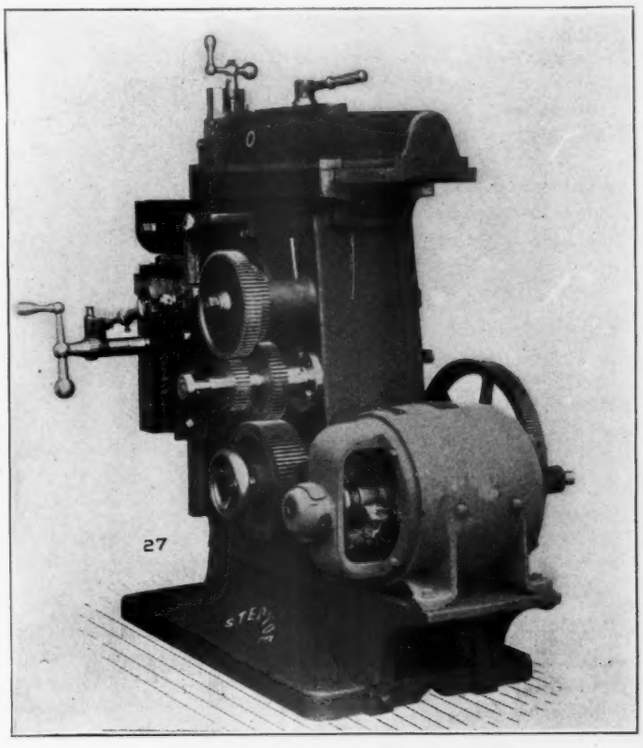
900,000 PATENTS.—The nine hundred thousandth patent from the United States Patent Office was issued September 29. It was granted too Charles D. Seeberger, of Yonkers, N. Y., and refers to an improvement on traveling stairs, such as are used in hotels and other large buildings. Mr. Moore estimates that the one millionth patent will be reached in the year 1911. The total of patents issued by the United States is not very far below the total for all other countries for all time.

"THE DENSITY OF TRAFFIC is, of course, the paramount feature as to the savings to be effected by electrification. It is not to be forgotten that, in electrifying, interest, depreciation, insurance and taxes follow closely on the heels of the capital investment in equipment and material necessary to electric operation. The heavier the traffic, the greater will be the economies derived from the two above mentioned sources."—*W. S. Murray, N. Y., N. H. & H. R. R.*

14-INCH CRANK SHAPER.

A crank shaper, which in mechanical construction differs from anything now on the market, has recently been brought out by the John Steptoe Shaper Company, of Cincinnati. This machine was built especially to economize on space, the original design being for use on a revenue cutter in government service, where the available room was exceedingly small. Reference to the illustration will show that the motor does not take up any extra room at all, being arranged to set on the base of the machine against the column, where it does not require any greater clearance than does the return stroke of the ram.

This is a 14 in. single geared machine driven by a 2½ h.p. motor. The pinion on the motor shaft is rawhide with brass flanges, being 2 in. in diameter and having 22 teeth. It meshes with the large gear 16 in. in diameter, with 190 teeth, giving a



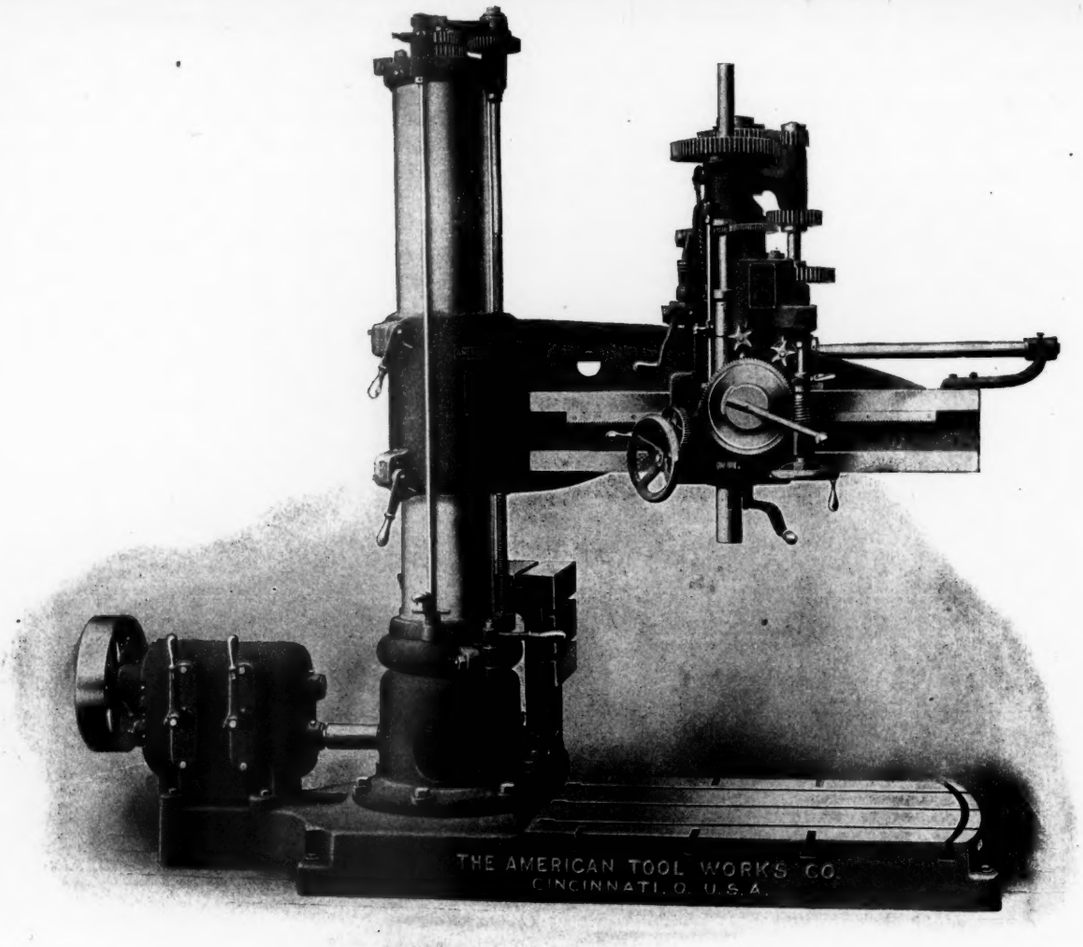
14-INCH CRANK SHAPER.

gear ratio of about 8 to 1. The shaft for the 16 in. gear has a 5 in. bearing on both sides of the column and carries at the opposite end the wide gear shown at the bottom of the train of gears in the illustration. This wide-faced gear is used in order to provide for the shifting of the compound gear arranged just above it. The compound gear contains a 6 and a 4 in. diameter wheel arranged on the same shaft so that when one is in mesh the other is thrown out. The hand wheel at the bottom is used to turn the gears sufficiently to make the compound gear mesh when it is shifted to change the speed.

The illustration shows the machine with the gear covers removed.

MEXICAN RAILROADS.—In a message to the Mexican Congress President Diaz says that 265 miles of new railroad have been built in Mexico in the last six months, and that on September 1 there was a total of 14,665 miles of railroad in the country. Practically all the new mileage is that of the Cananea, Yaqui River & Pacific Ry., which E. H. Harriman and his associates are building down the Pacific slope.

CHINESE RAILROADS.—Since the war with Japan the mileage of the Chinese railroads has materially increased. Including the Manchurian railroads there are now 3,200 miles of road in operation, an equal amount projected and 1,100 miles building.



FOUR-FOOT TRIPLE GEARED RADIAL DRILL.

TRIPLE GEARED HIGH SPEED RADIAL DRILL.

The introduction of high speed twist drills, particularly those of the Celfor pattern, has opened up a new field for extremely rapid drilling and has made it necessary to design drilling machines capable of pushing the twist drills to their full capacity. For this purpose the American Tool Works Company, Cincinnati, O., has brought out a full new line of radial drills, the 4-foot size of which is shown in the accompanying illustration These drills have surpassed all previous records for rapid drilling and heavy tapping, as is shown by the accompanying tests.

The 4-foot drill has a capacity for drilling to the center of an 8 ft. 1½ in. circle; has a clearance of 4 ft. 10½ in. between the spindle and the base; a 15 in. traverse of the spindle and a 3 ft. 4¼ in. traverse of the head on the arm.

The feeding mechanism on the head provides eight different rates of feed, which are all readily obtained by the simple turning of the dial on the feed box until the desired feed, indexed thereon, comes opposite a fixed pointer. The feed mechanism is of the all-gear type and is operated through a friction which will transmit more power without slipping than the drill or tap will stand. It thus forms practically a positive clutch, as far as the power is concerned, but still protects the feed gears.

The spindle has 24 changes of speed, ranging from 18 to 356 r. p. m., all available without stopping the machine. The speed box, of the geared friction type, provides four changes of speed and is so arranged that there is no shock to the parts when throwing in any speed.

By rounding the edges of the teeth of the gears in the triple gear mechanism and by a special feature, which is not given publicity, the gears may be thrown in at high speed with no shock to the parts, which makes the machine practically fool proof and facilitates rapid production. A tapping mechanism is carried on the head between the triple gears and the speed box, thus giving to the friction the benefit of the triple gear ratios, and making unusually heavy tapping operations possible. It also permits the taps being backed out at an accelerated speed.

The design of the machine structure is most substantial in every way, the column being of the double tubular type with a

Drilling and Tapping Tests.

DRILLING TEST IN STEEL 1″ THICK.

Size Drill	Speeds Revol's	Speeds Cutting Speed	Feeds Per Revol'n	Feeds Inches Per Min.	Back Gears Ratio	Back Gears Position	Actual H. P.	Amp.	Volts.
9/16″ H. S.	356	52.3′	.012	4.27	1.48	Top	4.2	14	224.
¾″ H. S.	313	61.5′	.012	3.75	1.48	"	10.8	36	"
1 1/32″ H. S.	188	50.9′	.024	4.51	1.48	"	9.0	30	"
1 3/32″ H. S.	188	56.9′	.024	4.51	1.48	"	9.3	31	"
1 23/32″ H. S.	128	57.6′	.024	3.07	4.22	Middle	8.4	28	"
1 31/32″ H. S.	167	86.2′	.012	2.00	1.48	Top	7.8	26	"

DRILLING TEST IN CAST IRON 2″ THICK.

Size Drill	Speeds Revol's	Speeds Cutting Speed	Feeds Per Revol'n	Feeds Inches Per Min.	Back Gears Ratio	Back Gears Position	Actual H. P.	Amp.	Volts.
½″ C.....	356	46.6′	.046	16.3	1.48	Top	5.75	19	226.
1″ C.....	216	56.6′	.046	9.9	1.48	"	5.45	18	"
1 3/32″ H. S.	313	84.5′	.046	14.4	1.48	"	13.2	44	224.
1 3/32″ H. S.	313	99.8′	.046	14.4	1.48	"	15.3	51	"
1 15/32″ H. S.	216	83.1′	.033	7.1	1.48	"	12.6	42	"
1 23/32″ H. S.	216	97.0′	.033	7.1	1.48	"	16.8	56	"
1 31/32″ H. S.	128	66.0′	.033	4.2	4.22	Middle	15.6	52	"
3½″ H. S.	60	55.0′	.024	1.4	4.22	"	10.2	34	226.

TAPPING TEST WITH PIPE TAPS IN CAST IRON 2″ THICK.

Diam. Tap	Speeds Revol's	Speeds Cutting Speed	Feeds Per Revol'n	Feeds Inches Per Min.	Back Gears Ratio	Back Gears Position	Actual H. P.	Amp.	Volts.
4″.....	18	21.2′	1/8″	2¼″	12.02	Bottom	6.6	22.	225.
5″.....	18	26.2′	1/8″	2¼″	12.02	"	7.7	26.	222.
6″.....	18	30.8′	1/8″	2¼″	12.02	"	9.0	30.	224.

patent clamping ring, which offers exceptional rigidity, the arm also being most carefully designed to give the greatest resistance to bending and torsional strains. The control of the mechanism for moving the head, arm, spindle, etc., is arranged at the most convenient points and the closest attention has been given throughout to time and labor-saving arrangements.

TWO VALUABLE NEW TOOLS.

A great deal is heard about the efficiency of the workmen and of machine tools, but comparatively little is said about the small tools around the shop, which, as a matter of fact, are the controlling feature of the efficiency of a good proportion of railroad shop men. The design, construction and condition of small tools in a shop require as close attention as do many seemingly more important features if the best results are to be obtained. This attention has been given in some shops with surprising results, and the tool makers are ably co-operating and have on their staffs some of the best mechanical talent in the country which is giving its whole attention to the improvement of small tools, with excellent results.

DOUBLE TANG DRILL SOCKET.

HIGH SPEED STEEL REAMER.

Among the most recent products of this kind are two tools being placed on the market by the Cleveland Twist Drill Co., Cleveland, O. One of these is a simple, but practical, socket for doing away with taper shank tang troubles. The other is a reamer which has high speed steel blades solidly joined to a body of special soft steel, which, while giving the advantage of the high speed steel cutters, can be sold at a price considerably below that of reamers constructed of this material throughout. These tools are shown in the accompanying illustration.

The double tang socket instead of having one slot like the ordinary socket has two, one above the other, the upper slot taking the regular tang of the drill, or reamer, and the lower one receiving a secondary tang. This secondary tang is considerably thicker than the regular tang and practically cannot be twisted off. It can be ground on the shank in a few minutes and in cases where the regular tang has been broken it permits the tool to continue in service with even a stronger drive than when new. This socket will fit any spindle having a regular taper hole and can be removed with the ordinary drift, a small piece of bar steel being inserted to compensate for the regular tang when it has been broken off. These sockets are listed at the same price as the regular sockets.

The "Peerless" high speed steel reamers have all the hardness and cutting qualities of the solid high speed steel tools, and at the same time are less brittle. The blades alone are hardened and are then fitted and solidly joined into a special soft steel body by a process which has been developed and patented by the

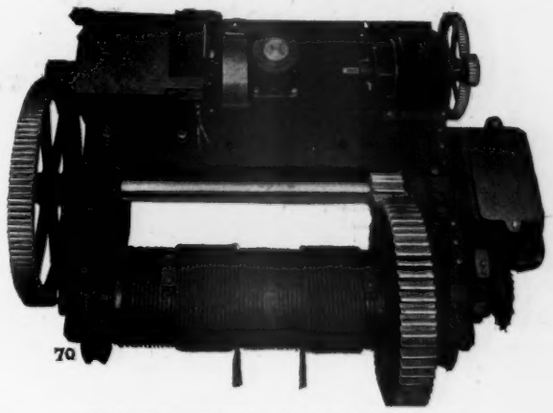
HIGH SPEED STEEL EXPANDING REAMER.

makers. This unites the steel blades with the body into one solid inseparable reamer.

Another form of Peerless reamers is also shown in the illustration in the shape of an expansion reamer, which are said to be the only reamer of this type that has the full number of cutting edges of the solid tool. It is also claimed that they will give considerably more expansion than carbon steel reamers of a similar design.

COMPACT ELECTRIC CRANE TROLLEY.

The application of electricity to traveling cranes has permitted the rapid and accurate handling of enormous weights, which has had so great a bearing on the largely increased output and efficiency of modern machine shops. The application of electric motors at this point has recently been given careful study by the electrical shop experts and consequent improvement with a large reduction in weight and size for an increased capacity has been made. The accompanying illustration shows an example of this in the shape of a five-ton trolley for a traveling crane, which is equipped with Crocker-Wheeler motors. The hoist motor is a seven h.p. machine of the box type and the rack motor 1½ h.p. of the circular type. Both of these motors, as can be seen, are very compact, taking up practically no room on



FIVE-TON TROLLEY FOR TRAVELING CRANE.

the crane and permit a very light construction throughout. They are both, however, easily accessible. A feature of this trolley is a mechanical brake, which operates in a submerged oil bath. The crane was built by the Cleveland Crane and Car Company, of Wickliffe, Ohio.

RELATIVE USE OF STEAM, WATER POWER, ETC.—Of the total estimated power at present produced by prime movers in the United States about 26,000,000 h.p. is produced by steam engines, 3,000,000 h.p. by water motors, and 800,000 h.p. by gas and oil engines. These figures emphasize the present position of the steam engine in our industrial development and the relatively much less important place now occupied by water power.—*H. St. Clair Putnam at the Conference on Natural Resources.*

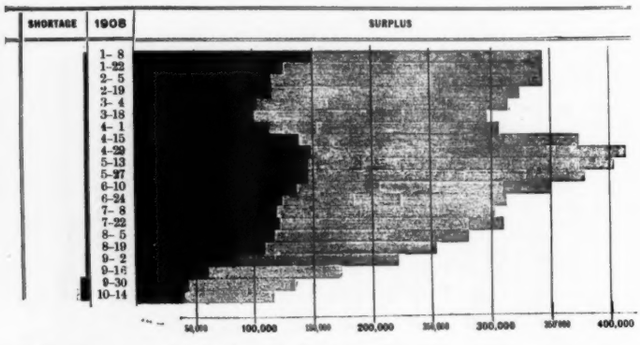
EXTENT OF PINTSCH GAS LIGHTING.

The following table shows the total number of cars and locomotives equipped with Pintsch Lighting System throughout the world, on April 1, 1908, and also the large increase during the past 4½ years:

Railroads in	October 1, 1903		April 1, 1908	
	Cars	Locomotives	Cars	Locomotives
Germany	42,471	5,583	52,846	7,958
Denmark	45	.....	45	.....
England	19,256	.....	20,459	.....
France	6,837	.....	11,914	.....
Holland	3,663	5	3,978	5
Italy	1,537	.....	1,552	.....
Switzerland	392	2	398	2
Portugal	67	.....	67	.....
Spain	38	.....	38	.....
Austria	5,003	.....	6,465	.....
Russia	3,467	132	4,428	329
Sweden	731	53	944	67
Servia	216	.....	219	.....
Bulgaria	98	.....	154	.....
Turkey	114	.....	119	.....
Egypt	148	.....	382	.....
United States	21,380	.....	32,455	.....
Canada	393	.....		.....
Brazil	978	31	1,324	31
Argentine	1,133	.....	1,548	127
Chile	46	.....	46	.....
India	10,312	.....	13,686	60
Australia	2,396	.....	2,945	.....
Japan	150	.....	180	.....
Total	120,871	5,806	156,172	8,579
Increase in 4½ years			35,301	2,773
Average increase per annum			7,845	616
Total average equipments per annum				8,461

FREIGHT CAR SITUATION.

Statistical Report No. 33, issued by the Committee on Car Efficiency of the American Railway Association, shows a total of 115,036 surplus cars on October 14, 1908, this being a decrease of 18,756 since the previous fortnightly report. It also shows a



slight shortage of both box and other types of cars reported from the Canadian & Pacific groups. The accompanying chart shows graphically the car shortage since January 8, 1908, the black portion representing the box cars and the shaded portion other types of cars.

BOOKS.

Foundry Work. By William C. Stimpson. Cloth. 145 pages. 6½ x 9½. Illustrated. Published by the American School of Correspondence, Chicago, Ill. Price, $1.00.

This forms one of a series of practical and scientific books for home study, being prepared by the American School of Correspondence, others of which we have mentioned in previous issues. The keynote of all these works is practicability. The present book is divided into three parts, the first treating on materials and the method of molding, in which all molders' tools and appliances are illustrated and their use described. The second part is on the making and finishing of castings and describes cupolas, furnaces, pressure blowers and other furnace appliances, proper method of pouring and a discussion of foundry work in all different metals and alloys. The third chapter is on shop management and contains a large number of useful tables, such as pressure in molds for different depths, proper temperature for molding different materials, specific gravities, etc.

Elements of Railroad Track and Construction. By Winter L. Wilson. 313 pages. 5 x 7½. Illustrated. Bound in cloth. Published by John Wiley & Sons, 43 E. 19th street, New York. Price, $2.00.

As the title indicates, the author of this book has not attempted to treat the subject in great detail, but has very successfully presented the fundamental principles, which will permit the reader to form an excellent general idea of the subject. The book has been prepared principally for class room work and with the idea that details of practice are much better and more easily learned by actual experience. Line drawings and photographs are used profusely in connection with the definitions and problems. In spite of the briefness of the work the subject has been covered in a surprisingly complete manner, there being practically no sub-division which is not considered in some respect.

Lighting Country Homes by Private Electric Plants. By T. H. Amrine. Bulletin No. 25 of the Engineering Experiment Station of the University of Illinois. Copies may be obtained gratis upon application to the Director, Engineering Experiment Station, Urbana, Illinois.

This bulletin calls attention to the fact that the present state of development of the storage battery and the recent production of the efficient tungsten filament incandescent lamp have opened up new possibilities in the way of country home lighting by private electric plants. The paper includes some explanations concerning artificial illumination, the selection of lighting fixtures and the planning of a house lighting system, the design and estimate of the cost of a small private plant, suggestions about ordering apparatus and instructions for its operation and care. The bulletin is intended for the non-technical reader and an attempt has been made to show the steps in the design in such a clear and simple manner that any person could decide upon the equipment needed and order it intelligently.

Cement Laboratory Manual. By L. A. Waterbury. Bound in cloth. 122 pages. 5 x 7½. Illustrated. Published by John Wiley & Sons, 43 East 19th street, New York. Price, $1.00.

The proper methods of procedure in testing Portland cements have an important influence upon the value of the results and the various associations interested in questions of this kind have devoted a large amount of time to preparing standards for making tests, without which, of course, comparisons or published results are comparatively worthless. While this book has been prepared for the use of students taking a course in cement laboratory practice at the University of Illinois, the information contained therein is of equal value to workers in any cement testing laboratory. It is, of course, more or less elementary and the first two chapters are devoted to instruction in the care of apparatus, general behavior in and about the laboratory and a complete illustrated description of all the apparatus to be used. The third chapter details the procedure in making various tests, which are illustrated by fourteen problems. Three appendixes give the reports of committees of the American Society of Civil Engineers, American Society for Testing Materials and the Society of Chemical Industry on this subject.

The Modification of Illinois Coal by Low Temperature Distillation. By S. W. Parr and C. K. Francis. Bulletin No. 24 of the Engineering Experiment Station of the University of Illinois. Copies may be obtained gratis upon application to the Director, Engineering Experiment Station, Urbana, Illinois.

This bulletin describes an attempt to remove from bituminous coals the heavy hydro-carbons and to produce a fuel essentially

smokeless. The original impetus to the experiments was given by the anthracite strike of 1902, efforts then being made to produce artificially, from Illinois coals, material which would be sufficiently anthracitic in character to supply the demand for that type of fuel. Certain unexpected results were obtained in connection with the temperatures at which the oxidation of coal may be effected, and a large part of this work, therefore, is a description of this phase of the subject. The striking interest in these experiments resides in the fact that the temperatures for rapid oxidation, especially with finely divided coal, are sufficiently low to bring this material within the range of conditions which are frequently met in storage. These results, therefore, have a direct bearing upon the weathering of coal, its spontaneous combustion, and probably, also, to a certain extent, upon the problems involved in mine explosions.

Concerning the production of a smokeless fuel from bituminous coals, high in volatile matter, the results are as yet incomplete. At a temperature not exceeding 400° Centigrade, a sufficient amount of hydro-carbons may be driven off to leave a substance closely resembling in composition the coals of the Pocahontas type. This material is exceedingly friable, and would need to be subjected to a process of briquetting. It has some of the characteristics of coke, but burns readily, and is especially well adapted for domestic use, being clean and smokeless. The commercial possibilities for the production of a smokeless fuel of this type have not been taken up, since the present work deals only with the scientific principles involved.

PERSONALS.

T. L. Smith, master mechanic of the Chicago, Burlington & Quincy Ry., at Beardstown, Ill., died September 29.

C. W. Tessiers has been appointed master car builder of the Mexican Central R. R., succeeding J. H. O'Brien, resigned.

W. M. Daze has been appointed to succeed Mr. George as master mechanic of the Santa Fé, with office at Winslow, Ariz.

John Mooney has been appointed assistant superintendent of motive power of the Grand Trunk Pacific, with office at Rivers, Man.

E. M. Sweetman has been appointed master mechanic of the Southern Railway at Sheffield, Ala., succeeding W. F. Moran, resigned.

A. T. Shortt has been appointed master mechanic of the Canadian Pacific Ry., at Cranbrook, B. C., succeeding A. N. Hobkirk, promoted.

R. F. Kilpatrick has been appointed assistant superintendent of motive power of the Denver & Rio Grande Ry., with office at Burnham, Colo.

Frank W. Taylor, general foreman of the Illinois Central, at Louisville, Ky., has been appointed master mechanic of the Peoria division, at Mattoon, Ill.

S. E. Kildoyle has been appointed master mechanic and master car builder of the Vera Cruz & Isthmus Ry., with headquarters at Sierra Blanco, V. C., Mex.

J. F. Casey has been appointed general foreman, car department, of the St. Louis, Brownsville & Mexico Ry., with headquarters at Kingsville, Texas.

A. H. Powell, master mechanic of the Denver & Rio Grande R. R., at Grand Junction, Colo., has been appointed master mechanic at Salt Lake City, Utah.

C. H. Osborn, master mechanic of the Chicago & Northwestern Ry., at Baraboo, Wis., has been appointed assistant superintendent of the car department, with office at Chicago.

A. J. McKillop, master mechanic of the Illinois Central R. R. at Freeport, Ill., has been appointed master mechanic of the Chicago division, succeeding T. F. Barton, resigned.

John Schrader, night car foreman of the New York Central & Hudson River R. R., has been appointed general foreman of the car department, Mott Haven yards, New York.

G. M. Crownover, assistant master mechanic of the Chicago division of the Illinois Central R. R., has been put in charge of the Burnside shops, and the former position has been abolished.

J. T. Carroll, assistant master mechanic of the Lake Shore & Michigan Southern Ry., at Elkhart, Ind., has been appointed master mechanic of the Lake Erie & Western Ry., at Tipton, Ky.

W. J. Hoskin, master mechanic of the Chicago Great Western Ry., at Des Moines, Iowa, has been appointed master mechanic of the Chicago & Alton R. R., with headquarters at Bloomington, Ill.

R. R. Royal has been appointed foreman in the locomotive and car department of the Mobile, Jackson & Kansas City Ry., at Louisville, Ky., succeeding G. W. Brewer, assigned to other duties.

C. C. Reynolds has been appointed road foreman of engines of the Santa Fé (Coast Lines) at Winslow, Ariz., with jurisdiction over the Albuquerque division, succeeding William Daze, promoted.

A. R. Ayres, assistant superintendent of shops of the Lake Shore and Michigan Southern Ry., at Collinwood, Ohio, has been appointed to succeed Mr. Carroll, as assistant master mechanic at Elkhart, Ind.

T. F. Barton, master mechanic of the Chicago division of the Illinois Central R. R., has been appointed master mechanic of the Morris and Essex division of the Delaware, Lackawanna & Western R. R.

V. U. Powell, master mechanic of the Peoria division of the Illinois Central R. R., and the Indianapolis Southern Ry., at Mattoon, Ill., succeeds Mr. McKillop as master mechanic, at Freeport, Ill.

M. S. Curley has been appointed master mechanic of the Beaumont, Sour Lake & Western, the Colorado Southern, New Orleans & Pacific and the Orange & Northwestern at Beaumont, Tex., succeeding A. L. Moler, resigned.

W. A. George, master mechanic of the second and third divisions, has been appointed to succeed Mr. Harlow as master mechanic of the first district of the Albuquerque division of the Santa Fé, with office at Albuquerque, N. Mex.

E. H. Harlow, master mechanic of the first district of the Albuquerque division of the Santa Fé (Coast Lines), has been appointed master mechanic of the Valley division, with office at Richmond, Cal., succeeding A. B. Todd, resigned.

F. W. Thomas, supervisor of apprentices of the Santa Fé, has been appointed also engineer of tests, succeeding T. E. Layden, assigned to other duties. All matters pertaining to tests should be addressed to Mr. Thomas as engineer of tests, and all matters pertaining to apprentices should be addressed to him as supervisor of apprentices.

CATALOGS

IN WRITING FOR THESE PLEASE MENTION THIS JOURNAL.

FLEXIBLE STAYBOLTS.—The Flannery Bolt Company, 328 Frick Building, Pittsburgh, Pa., are sending out a flyer calling attention to the success the Tate flexible staybolt has had during the past four years. A list of the representatives of the company is given.

LOGARITHMETIC CROSS SECTION PAPER.—A circular, which comprises a sample, on the back of which is illustrated the method of using and the value in many computations of the Jensen logarithmetic paper, is being sent out by J. Norman Jensen, 797 N. Leavitt street, Chicago.

HIGH SPEED DRILLS.—Catalog No. 4 from the Hackett High Speed Drill Company, 90 West street, New York City, contains a description of the Hackett high speed drill and gives price lists of the various sizes.

CRANES FOR RAILROAD SERVICE.—The Whiting Foundry Equipment Company, Harvey, Ill., is issuing a booklet which illustrates cranes of practically all types that have been installed by this company in various railroad machine, erecting and boiler shops, as well as transfer tables and cranes for outdoor service. The illustrations include electric, pneumatic, and hand types in all capacities.

CONVEYING MACHINERY.—The Jeffrey Manufacturing Company, Columbus, O., is issuing a number of bulletins and catalogs illustrating and describing the conveyor belt and other types of conveyors for practically any commodity and under any conceivable circumstance. The illustrations show most of this apparatus in actual service and cause surprise at the widespread adaptability of this method of labor saving. Other bulletins are issued by the same company on the subjects of coal washing plants and equipments and coal tipples and shaking screens.

PLANERS.—The Cincinnati Planer Company, Cincinnati, O., is issuing catalog No. 10, which most attractively illustrates and describes the imposing array of various types of planers manufactured by it. The details of construction are very carefully illustrated and described. Several machines are shown which have a variable speed device, consisting of a speed box mounted on top of the housing. This provides for six different cutting speeds with the same return speed. There is nothing in the planer line that is not manufactured by this company.

CONSOLIDATED SUPPLY COMPANY.—Catalog No. 15 being issued by the above company, whose office is in the Manhattan Building, 321 Dearborn street, Chicago, is of the loose leaf form and binds together a number of bulletins on the large variety of railway supplies handled by this company. Among these might be mentioned the Consolidated patented metal car roof, an example of which is shown by a photograph as still in excellent condition after five years' service. This type of car roof is just being put on general sale. This company handles the Monarch couplers for locomotives and cars and are agents for the Reading multiple gear chain hoists and the Northern fire extinguisher. They are also manufacturers' agents for a large variety of railway supplies, mentioned in this catalog.

BRILL'S MAGAZINE.—The October 15th issue of *Brill's Magazine* contains an excellent illustrated description of the interurban system and cars of the Lewiston, Augusta and Waterville Street Railway. It also has some excellent photographs and a very complete description of the exhibit of the J. G. Brill Company at the Atlantic City convention of the American Street and Interurban Railway Association. This exhibit comprised a number of sample cars on a track alongside the pier in addition to a large amount of space inside given up to an exhibit of trucks and smaller details. The magazine also contains a number of interesting short articles, principally in connection with the "Pay-as-you-enter" cars. Some passenger and baggage cars that have been built for steam railways in the Argentine Republic are also illustrated and described.

COLLAR OILING BEARING.—The Hill Clutch Company, Cleveland, O., is issuing a small supplementary catalog which is a reprint of a portion of its catalog F, and describes collar oiling bearings in various mountings. This type of bearing is so constructed that the oil is stored in a large reservoir at the bottom of the bearing and by the means of the revolving of a split collar clamped to the shaft is continuously lifted to twin reservoirs in the upper half of the bearing, from which it is distributed to the bearing surface by gravity. The bottom reservoirs are arranged for the separation of any dirt or grit and the bearing is so constructed that the oil will not creep along the shaft and it will operate for months without refilling. These bearings are shown in practically every type of mounting, the sizes and prices of each being given in the catalog.

SCHERZER ROLLING LIFT BRIDGES.—Rolling lift or bascule bridges have such evident and numerous advantages that they are being installed in large numbers in the more thickly settled centers of population. Those of the Scherzer type form a large proportion of the best installations and this catalog, which is really an excellently written and printed, cloth bound book, illustrates a large number of examples now in operation. Part of the catalog is devoted to the development of this type of bridge, from the draw bridge of ancient times through various types of trunnion and bascule bridges. A very interesting suggestion concerning an elaborate improvement of the Chicago harbor is also discussed. A partial list of bridges now in operation or under construction, in various parts of the world, forms an interesting part of the catalog. The address of this company is Monadnock Building, Chicago.

ELECTRICAL APPARATUS.—Among the bulletins recently issued by the General Electric Co., are No. 4621, which illustrates and describes luminous arc lamps for multiple circuits. This lamp is intended primarily for use in foundries, machine shops, freight houses, etc. No. 4618 describes the new form of polyphase generator designed especially for use in small power plants and isolated lighting plants. Other bulletins are No. 4622 on polyphase maximum watt demand indicators; No. 4616 on high voltage type H transformers, and No. 4619 on steady vs. unsteady voltage.

FOUNTAIN PENS.—One of the most artistic catalogs which we have ever had the pleasure of examining is that issued by L. E. Waterman Co., 173 Broadway, New York. This is a cloth bound book of 83 pages, printed on heavy glazed paper in two colors and having emblematical illuminated drawings as chapter headings. The book opens with a chapter headed "A Dream and Its Realization," in which an account is given of Mr. Waterman's invention of the first successful fountain pen in 1883, and the wonderful development in this industry and company since that time. Following are descriptions of the method of manufacture and the operation of the Waterman pen. Excellent illustrations are given of the great variety of styles and numerous sizes in each style of pen manufactured by this company. Many of these are most elaborately mounted with gold and silver filagree work, which is very beautifully portrayed in the illustrations by means of the color work. Pens for special uses and a self-filling type of pen form the subject of another section. Pens with various emblematic mountings are illustrated, as are also various appliances for use with fountain pens, such as safety pockets, cleaners, fillers, etc.

NOTES.

GRAND TRUNK RAILWAY TO ORDER LOCOMOTIVES.—The New York *Herald* reports that the Grand Trunk Railway is in the market for 100 locomotives, which order will be placed about January 1st.

WOOD'S IMPROVED BOILERS FOR THE NEW YORK CENTRAL.—William H. Wood, Media, Pa., has recently delivered two boilers incorporating his corrugated Fire Box and flexible tube plates to the New York Central Railroad for application to consolidation locomotives. This type of boiler was illustrated and described on page 190 of the May, 1908, issue of this journal.

AMERICAN LOCOMOTIVE COMPANY.—Robert J. Gross, vice-president in charge of the domestic and foreign sales of the American Locomotive Company, has resigned to devote his entire time to other interests. James McNaughton, manager of the Schenectady Works, has been elected vice-president to succeed Mr. Gross, and W. L. Reid, superintendent of the Schenectady Works, has been appointed manager of that plant to succeed Mr. McNaughton.

LOCOMOTIVES ORDERED.—Among the recent orders of locomotives are included twenty-five 10-wheel type and fifteen 6-wheel switchers for the Chicago & Northwestern Railway and twenty-five Prairie type and thirteen 10-wheel type for the Chicago, Milwaukee & St. Paul Railway to be built by the American Locomotive Company. The latter road has also ordered twelve Atlantic type Vauclain compounds from the Baldwin Locomotive Works.

THE PARKESBURG IRON COMPANY, makers of charcoal iron, skelp, and boiler tubes, Parkesburg, Pa., have opened an office on the twenty-sixth floor of the Singer Building, New York City. Mr. J. A. Kinkead, until recently Engineer of Tests for the American Locomotive Company, has been placed in charge as Manager of Sales. Mr. Kinkead is an Associate Member of the American Society of Mechanical Engineers, Member of American Society of Testing Materials, and was for nine years chief inspector of the Chicago & Northwestern Railroad.

WARD EQUIPMENT COMPANY.—At a meeting of the stockholders of the Ward Equipment Company, held at 141 Broadway, New York, on October 12, John E. Ward was elected president; Alfred W. Kiddle, vice-president, and T. V. Bates, secretary and treasurer. A. E. Robbins was appointed eastern representative and Henry G. Horn western representative. On account of the rapidly growing business in the car heating and ventilating departments of this company, the president was authorized to either purchase or erect a suitable building in New York where the offices and warerooms of the company could be located.

CASH PRIZES FOR THESES ON AN ELECTRIC CAR DESIGN.—The J. G. Brill Company, Philadelphia, offers three cash prizes, aggregating $500, for the three best theses on the design and construction of an electric railway car for city service, open to the senior students of the technical schools of the U. S. The subject may be considered from any standpoint the student may elect and will be judged on its technical merit and on the manner in which the subject is presented. Other information concerning the contest may be obtained by addressing the Technical Department of the J. G. Brill Company, Philadelphia, Pa.

ORGANIZATION.

Motive Power Department.

LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

FOREWORD.

Being a description of what is believed to be the finest railroad motive power or mechanical department organization on this continent, not only as concerns the form of organization but what is far more important, the spirit of co-operation and enthusiasm, in working for the best interests of the road as a whole, which permeates it. It is difficult to convey by words the full force, or even a correct impression, of this spirit, which is so necessary to bring about the best results in any cause and which is so evidently the secret of the successful organization. Even those who are responsible for the development of this improved organization find it difficult to define in the abstract the fundamental principles which made it a success.

Unfortunately the subject is one which does not admit of using the art of the photographer to tempt the eye and arrest the attention of the reader, thus encouraging him to study into its details. We believe, however, that it is the most important article which has ever appeared in this journal, and we urge our readers to give it careful consideration, no matter what department or class of work they are engaged in, for the general principles underlying it are applicable to any organization. No more important problem is before the railroads to-day—not only in the mechanical, but all departments—than that of efficient organization.

In connection with the study of this subject some important features were noticed, which, while they are not strictly matters of organization, are an outcome of it and were closely allied to its development. We have included a description of a few of these features, such, for instance, as the engine-house work reports and the effect of these and the efforts of the mechanical engineering department in reducing the number of engine failures. To assist in the study of the organization charts a map of the system has been included.

WHAT IS A GOOD ORGANIZATION?

The effectiveness of an organization must be judged by its ability to increase the efficiency of the department, or concern, as a whole. This result can only be obtained by improving the efficiency of each individual in the organization, from its head to the least important employe. This requires ample supervision working along definite lines and based on certain important fundamental principles.

It is possible for a strong and gifted leader, by pure force of personality and with a poor organization to back him, to bring about fair results; but, let him leave it even for a short time and the efficiency immediately falls off. It is further true that in a large organization of this class he cannot bring the efficiency above a certain point because he will be swamped by details, even though he is of exceptional capacity, and cannot give sufficient thought and attention to the larger problems which must be solved to guide it properly.

One of the cardinal principles of a good organization is that every officer and foreman in it should see that he has under him a man who can successfully take his place, either temporarily or permanently. A test of a good organization is whether the efficiency is appreciably affected by the absence of any one man.

Good organization means that there is team work and co-operation between its different branches or departments, in fact that department lines are practically lost sight of, and the men press on enthusiastically, shoulder to shoulder, not for the success of any one department, but for the success of the organization as a whole.

To make an organization permanent, it is necessary to have the line and staff officers in direct accord with the policy of the head of the department. This policy and the form of organization must be so clearly understood that each line and staff officer is a capable instructor of those under him. This can only be done by earnest and enthusiastic effort on the part of all men in authority from the top to the bottom of the organization.

GENERAL PRINCIPLES UNDERLYING A GOOD ORGANIZATION.

The general principles are not by any means arranged in the order of their importance; as a matter of fact it is questionable if it would be possible to do this. Ask any of the men who have been most enthusiastic in developing the organization on the Lake Shore what they consider to be the most important principle underlying it and they will stop, and think a moment, and then relate an incident illustrating some phase of it which has specially appealed to them. The principles, which are outlined below, represent in a general way the thoughts which were brought out in this manner.

Good Leadership—Team Work—Enthusiasm.

An efficient organization demands a strong leader who can command the confidence of the men and who is able to enthuse and bring out the very best in each of them; not this only, but his subordinates must be developed to have the same influence on those reporting to them, and so on down to the men in the ranks. An officer or subordinate who is not capable of being thus developed has no business holding a responsible position in the organization. A spirit of loyalty and co-operation must be built up and permeate the entire organization. The establishment of this spirit of team work dates from a change in the motive power department organization which was made about ten years ago. Upon this as a foundation a complete reorganization of the department has taken place during the past few years. The development of this esprit de corps will result from the application of the following principles.

Synopsis.

	PAGE
Foreword	453
What Is a Good Organization?	453
General Principles Underlying a Good Organization	454
Good Leadership—Team Work—Enthusiasm	454
Eligibility to Promotion	454
Promotion of Men from the Ranks	454
Taking Officers and Foremen from the Organization	454
Permanency of a Good Organization	455
Supervision	455
Specialization	455
Relation of Officers to Subordinates	455
Young Men and Responsibility	455
Check on Individual Efficiency	456
Records and Statistics	456
General Organization—The Staff and the Line Officers	456
Organization of the Mechanical Engineering Department	457
Organization of the Master Mechanics' or Locomotive Operating Department	459
Individual Efficiency Records	459
Power Meetings	460
Enginehouse Work Reports	461
Engine Failures	461
Organization Chart and Labor Cost Sheet	464
Car Department Organization	464
Passenger Car Failures	465
Collinwood Locomotive Shops	467
Organization Charts	468
Efficiency Card System	468
Clerical Force—Duties of the Chief Clerk or Secretary	468
The Clipping Bureau	470

Eligibility to Promotion.

No man is eligible to promotion unless he has a man under him who can step up and take his place and produce as good or better results.*

It should not be necessary to go outside the organization for men to fill any position, even the highest, but all appointments should be made from within it. Surely something is radically wrong when a railroad, employing thousands of men in the mechanical department, must go outside the organization for its officials. Is it because the proper material is not there, or cannot be developed, or is it because the men who are making the appointments are not keen enough to discover it, or have such a poor organization that good men cannot be developed? Such things may be excusable when conditions are so bad that it is necessary to effect a complete reorganization, but this conditon should not exist long thereafter.

It is distinctly understood by all that in order to receive a promotion each must have a man under him capable of filling his position, and must necessarily have previously called the attention of his immediate superior officer to the qualities of this man in order that he may be familiar with the development of the growing organization.

Promotion of Men from the Ranks.

The men selected to be promoted from the ranks receive the most careful consideration for they must have those qualities, which properly developed, will fit them for the highest positions in the organization. This is especially important from the fact that if such men are promoted and are not capable of being developed to a certain point, they block the way for advancement of the men under them. It is a mistake, after a man has once been promoted from the ranks, to reduce him, for he will be dissatisfied and become a menace to the organization. For this reason and in justice to the men, they should be promoted only after the most careful consideration.

Taking Officers and Foremen from the Organization.

An organization may be likened to a triangle, the rank and file composing the base, the head the apex, and the department heads and their subordinates the space between. If a number of lines be drawn from the base to the apex, they may be considered the paths along which promotions are made. In advancing upward a man may jump from one line to another, but the progress will always be upwards. If men are to be transferred to some

* This is contrary to the old idea which is indeed still held by many men in more or less important positions. We have all met men, either in the shop, on the road, or in the office, who insisted on doing certain things themselves and seemed to surround the operations with mystery, giving the impression that they were beyond the understanding or ability of the average man. How surprised we often were, when we discovered the details of the process, to find how simple it really was. The official or foreman who imagines that he can strengthen his position in the organization by doing this is making a big mistake. He can make a much better record by shifting as much detail as possible on his subordinates, thus giving him more time for the general study and direction of the work.

If a man under you is doing exceptionally good work, or has discovered a new and better method or device for doing the work, give him the proper credit and let it be known. Both he and those about him will be encouraged to do better work and the efficiency of your department will be correspondingly increased. It is the men who are big enough to encourage and develop the men under them, in this way, that are fast filling the most responsible positions on railroads and in industrial establishments. The "one man" business, or department, is becoming a thing of the past.

other organization it is better that they be taken from near the top in order to give as many men as possible an opportunity for promotion.

Permanency of a Good Organization.

A question which will undoubtedly suggest itself to the reader, is, what will happen if the head of the department is taken away. With the organization properly and well established, it would make no difference, as the officers and foremen have gradually developed and absorbed the spirit of the organization.

If a man reaches a certain position and does not line up properly his associates, who come in contact with him, will undoubtedly bring pressure to bear upon him, and if he does not "line up" he will be forced out. Suppose, for instance, that a master mechanic, newly appointed, develops traits which cause friction between himself and another master mechanic, or possibly, the shop superintendent or mechanical engineer. These three men, who are accustomed to team work, will get together and talk the matter over, after which they will possibly arrange to meet the master mechanic in question and frankly talk matters over with him. If he is the proper kind of a man for the position he will see the point and cooperate with his associates; if not, the best thing for him to do is to step out. In this way a good organization, when once well established, develops itself and any man, no matter what his position, will be automatically eliminated or wedged out if he does not conform to its principles. Thus a man who reports directly to the superintendent of motive power and is in intimate touch with him, must necessarily have the proper stuff in him and have absorbed the principles which made the work a success, and will, therefore, be especially well fitted to take his place if his superior should be called away.

Supervision.

An examination of the diagrams or charts of the organization of the different branches of the department shows that a very thorough and complete supervision has been provided for. It is difficult to realize the amount or extent of supervision until it is properly diagramed. When an organization cannot be properly diagramed, its weakness becomes apparent. The very act of making supervision charts is a liberal education.

The great difficulty is that the matter of supervision is not given sufficient attention, probably because added supervision apparently increases the expense of the department. As a matter of fact there are very few roads which could not increase their supervision quite largely, with a resulting increase in efficiency of the department as a whole.

Too often a high salaried officer is handicapped by a large amount of details which should be handled by his subordinates. A high salaried man without this assistance is often only giving his company a small proportion of the returns which he could if he had the proper assistance.

Specialization.

One of the fundamental principles of efficient organization is the specializing of work to a high degree. This is not only true of the rank and file, where the object has been to some extent accomplished by the adoption of piece work, but also throughout the service and especially in connection with the general staff where each man is an expert in his particular line.

Relation of Officers to Subordinates.

Criticism of subordinates is constructive, not destructive. Petty fault-finding is eliminated and the superior officer in a firm, patient, diplomatic way encourages and develops the subordinate by showing him how to remedy and overcome his weak points. The development of many good men is often stunted because of a spirit of fault finding on the part of their superiors.

It is difficult for even a good man to retain his self-respect and the enthusiasm which he should for his work, when in receipt of such letters as are sent out daily on many roads.*

The subordinate knows that it is his duty and privilege to speak frankly to his superior. The officers invite frank criticism from the men under them, realizing that in many instances they are closer to the actual work and often better able to judge from the particular standpoint than they are.

Young Men and Responsibility.

Young men are developed and promoted to positions of responsibility. The reasons for this may be briefly stated by quoting from an editorial in our January issue:

"One of the common faults in those who have the management of large forces is that of not thoroughly understanding the elementary fact that if we desire to keep our positions as foremen and executives, it is necessary to keep our forces young. To make this clear it may be truly said that if we keep our forces young it does not matter how old we may be ourselves, we will be practically sure of retaining our positions.

"It should be distinctly understood that men are capable of accepting positions of responsibility when they are very young. As an illustration we might say that when a man is twenty-one he should be advanced to a position of responsibility where it is necessary for him to handle a number of men. The common fault lies in the fact that we usually consider those under us young if thev are slightly younger than ourselves."

* A man who has come up from the ranks—a big broad fellow, physically and mentally—and now holding a position near the "top of the heap," when in a confidential mood told of the following experience. He had been promoted to the position of master mechanic and was stationed on one of the worst divisions of a northwestern road. Storms and blizzards had blocked the road but by almost superhuman efforts, and at the risk of life and limb, the power had been maintained and the blockade broken, largely because of his efforts. He was congratulated by his superiors and naturally felt more or less pride in the achievement, especially since, although a new man, he had demonstrated his fitness for the position.

The superintendent of motive power was very friendly and apparently took a great interest in him, but, as the master mechanic expressed it, he would receive the "nastiest" kind of letters from headquarters criticizing or calling attention to comparatively unimportant details. He finally became discouraged and made up his mind that if he was to keep his self-respect it would be necessary for him to resign at once. He took the matter up with the superintendent of motive power and was told to go back to work, that his services were entirely satisfactory and that he should not take things quite so seriously, *as it was the business of the superintendent of motive power to find fault and criticize those under him.* A good many people seem to be afflicted with the same idea, at least to some extent, but it should have no place in a good organization.

Check on Individual Efficiency.

An important feature of the organization is the system of checking the efficiency of the men. The individual efficiency of a large percentage of the mechanics in the shops has been improved by the introduction of piece work, the results of increased efficiency being largely proportional to the study, care and common sense given to installing it properly.* At the present time practically all of the car department repairs and a large percentage of the locomotive shop repairs on the Lake Shore are done on a piece work basis.

The New York Central lines apprenticeship system** is a decided success and is gradually developing a superior class of mechanics for the perpetuation of the organization.

The individual efficiency records which will eventually cover all the men within the organization of the motive power department, have already made a material improvement in the personnel of the organization.

GENERAL ORGANIZATION.

A study of the chart showing the general organization of the motive power department brings out several interesting features. For instance, the mechanical engineer is an executive officer, being next in command to the assistant superintendent motive power. When given this importance in the organization the machinery at his disposal can be keyed up to such a pitch that it really becomes the keynote of the mechanical department, and so it should be. Unfortunately this holds true on very few roads and, as a matter of fact, it cannot be true where the mechanical engineer's department is from three months to three years behind the rest of the department, showing that its work consists largely of recording what has already been accomplished. When it is given sufficient backing to lead the other departments, then it assumes its real importance and takes its proper place in the organization.

It will be seen that the general form of organization is quite similar to that of an army, and consists of a line organization made up of the superintendent motive power, assistant superintendent motive power, mechanical engineer, master mechanics, master car builders and superintendents of shops, and so on down to the men in the ranks. There is also a general staff consisting

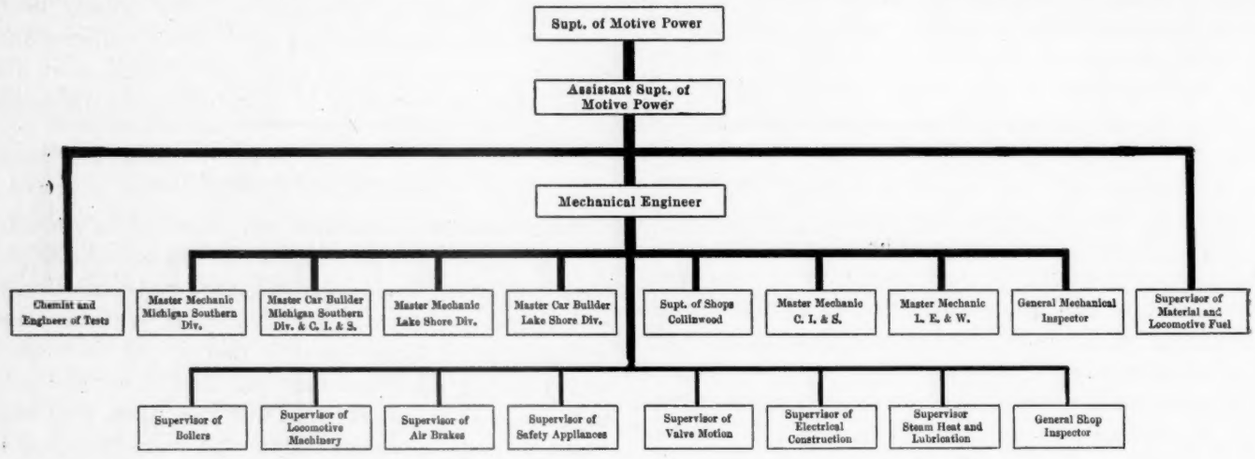

Supt. of Motive Power
Assistant Supt. of Motive Power
Mechanical Engineer
Chemist and Engineer of Tests
Master Mechanic Michigan Southern Div.
Master Car Builder Michigan Southern Div. & C. I. & S.
Master Mechanic Lake Shore Div.
Master Car Builder Lake Shore Div.
Supt. of Shops Collinwood
Master Mechanic C. I. & S.
Master Mechanic L. E. & W.
General Mechanical Inspector
Supervisor of Material and Locomotive Fuel
Supervisor of Boilers
Supervisor of Locomotive Machinery
Supervisor of Air Brakes
Supervisor of Safety Appliances
Supervisor of Valve Motion
Supervisor of Electrical Construction
Supervisor Steam Heat and Lubrication
General Shop Inspector

CHART SHOWING THE GENERAL ORGANIZATION OF THE MOTIVE POWER DEPARTMENT.

Records and Statistics.

It is important that accurate records and statistics be kept so that comparisons may be made from month to month and that the costs may be analyzed. In doing this, care should be taken not to pile up a lot of useless or unreliable records. This is too often the case. It is also important that these statistics be arranged so that they may be studied by the officers at the expense of a minimum amount of energy. Graphical records may often be used to advantage.

While system is a vital point in a good organization it should be remembered that common sense must govern in all cases and that too much system is often far worse than not enough.

of the chemist and engineer of tests, a supervisor of materials, supervisor of boilers, supervisor of locomotive machinery, supervisor of air brakes, supervisor of safety appliances, supervisor of steam heat and lubrication, supervisor of electrical construction, supervisor of valve motion and general shop inspector.

The supervisor of materials examines and checks all requisitions and keeps in touch on the road as regards all material, including fuel.

The chemist and engineer of tests reports direct to the assistant superintendent motive power, and has direct supervision over all physical and chemical tests in all departments.

The advantages of this form of organization were briefly considered in an editorial in the October issue. The men on the general staff are carefully selected and are specially fitted to take charge of the work to which they are assigned. They give their entire time to studying and improving the conditions of their special work and co-operate closely with the line officers in seeing that such instructions as have been issued are carried out, and that the efficiency is raised to the highest possible point. The general staff meets with the superintendent motive power every two weeks. In the absence of the superintendent motive power the meeting is in charge of the assistant superintendent motive power, and in his absence is conducted by the mechanical engineer.

The first action considered at these meetings is always one concerning the saving of either labor or material. This is a standing subject which is very freely discussed. In addition to this each member of the staff is assigned subjects pertaining to his particular line. These subjects are usually developed from sug-

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* A valuable article entitled "Piece Work," with particular reference to the car department, although the general principles apply equally well to the locomotive department, contributed by LeGrand Parish, appeared in the September, 1904, issue of this journal.

** A complete description of the New York Central Lines apprenticeship system appeared in this journal during 1907 and may be found in the June, July, September, October and November issues of that year. An abstract of the proceedings of the second annual conference of the apprentice instructors will be found in the October, 1908, issue. The vital principles of a successful apprentice system, as outlined by the apprenticeship committee of the Master Mechanics' Association, and which have recently been adopted by letter ballot as the recommended practice of that association, will be found on page 276 of the July, '08, issue.

gestions made at staff meetings and are open to discussion by all members of the staff. The educational value of this system will be readily understood. These meetings have been held for the past two years with excellent results. Before this form of organization was developed it was not possible to get the same efficiency because efforts of the staff members were individual rather than concerted. Soon after these meetings were started it developed that their duties were no longer those of inspectors but of supervisors and their titles were changed accordingly.

The first meetings of the general staff under the new order of things were rather dull, until after careful coaching they came to understand that they were expected to suggest and furnish the information on which the superintendent motive power was to base his instructions; and still more, that it was necessary for them to practically formulate the working instructions for the class of service over which they had jurisdiction.

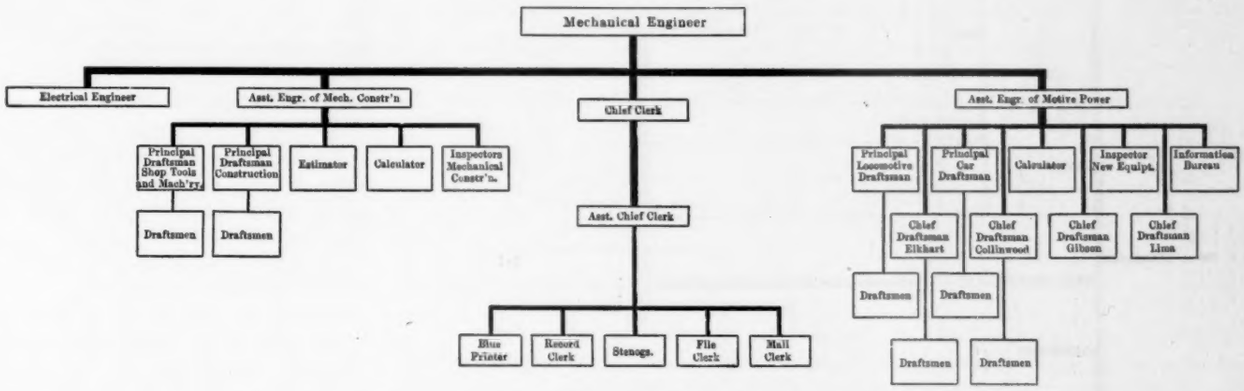
The efficiency of these men and, as a result, the efficiency of the organization, has been considerably improved by having it clearly understood that they are in no sense detectives, but that their duty is to cordially co-operate with the line officials in bringing up the efficiency and standardization of the work in their branch of the service. When the staff officers see anything which needs attention it is taken up with the local official. If the matter is peculiar to that one locality, the local officer promptly takes the investigation are frequently referred to committees for special study.

The difference between the organization on the Lake Shore and the United States army organization is that promotions are not entirely by seniority, although in the past few years the army has changed considerably in this respect. As a matter of fact, a man who is incapable of being promoted is eliminated as quickly as possible from the organization. Quite often several officers are in line for promotion to a position which is open; generally speaking it is given to the man who possesses the greatest merit.

ORGANIZATION OF THE MECHANICAL ENGINEERING DEPARTMENT.

The mechanical engineer's department is considered at this point, because it is one of the most important branches of the motive power department, since it should anticipate the wants of the other branches and keep in advance of them. The fact that the mechanical engineer is an executive officer, as shown in the preceding section of this article, has done much to bring up the efficiency of the department as a whole.

Under the former system the chief draftsman, reporting direct to the mechanical engineer, had in charge the design of all rolling stock and was in charge of the clerical force and looked after the routine correspondence of the department; the draftsman in



ORGANIZATION OF THE MECHANICAL ENGINEERING DEPARTMENT.

necessary action. If, however, it is general, it is taken up at the general staff meeting.

Because the staff officers are specialists it must not be considered that the staff meetings are at all one-sided and dull. Most subjects which are considered in some way touch upon the interests of several members of the staff, and as all of these officers are men of more or less general experience and are constantly going over the road, they are, of course, familiar with the conditions affecting almost any branch of the service. They do not hesitate to call attention, in a good-natured way, to things which they have seen can be improved and are under the immediate charge of other members of the staff. The discussions are very frank and to the point, but underlying them all is a strong feeling of co-operation.

The staff has a secretary who keeps the minutes of the meetings and to whom they report their location each day; in this way it is possible to reach them quickly at any time. While these reports indicate the special work upon which they are engaged at the time, it must not be assumed that they are hampered by instructions, for inasmuch as they are held responsible for the improvement of their branch of the work, they are necessarily free-lances and many valuable improvements have been made at their suggestion.

The line officers meet with the superintendent of motive power once a month for general discussion of matters pertaining to the department. The line officers also hold meetings with their subordinates at regular intervals on matters pertaining to their respective divisions, and so on down the line. In connection with the meetings of the line officers different topics which are under charge of shop tools, machinery and construction, was supposed to report to him. Under these conditions he was swamped with so much detail and routine work that he had very little time to give to the broader work of directing the maintenance design of equipment.

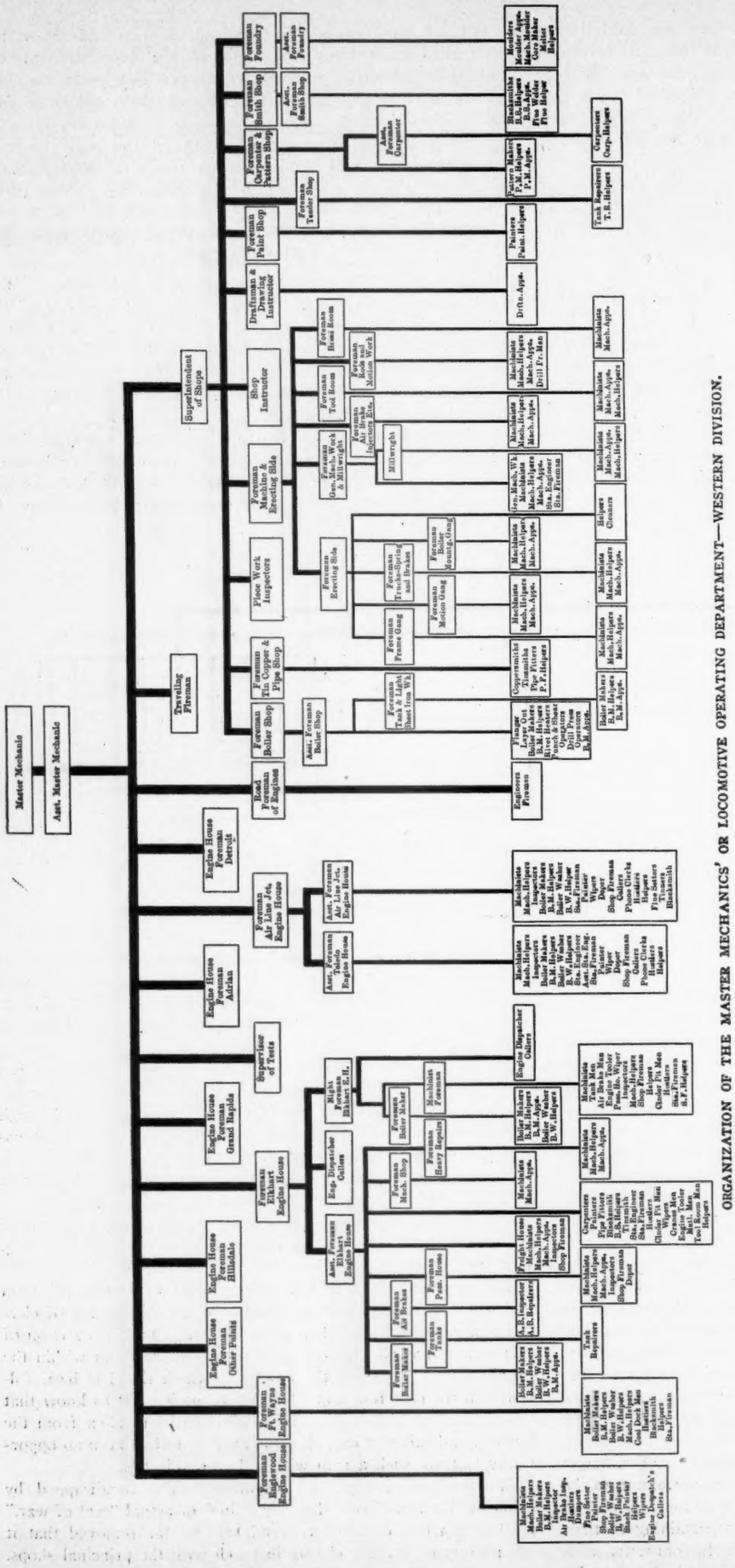
Under the present arrangement the mechanical engineer has three men reporting direct to him, each one of whom is responsible for a certain line of work, as indicated by their titles, although necessarily their interests often dovetail so that they must co-operate closely with one another.

The assistant engineer of motive power is in charge of matters relating to the maintenance design of locomotives and cars.

The assistant engineer of mechanical construction is in charge of matters relating to shop and enginehouse equipment, shop tools and machinery.

The electrical engineer is a new member of the organization and has in charge all matters relating to the engineering of electric power and lighting. It has been said in a previous section of this article that all promotions should be made from within the organization. To show the extent to which this has been followed in the past few years it might be of interest to know that this is the only important official who has been taken from the outside, and this was only done because there had been no opportunity to train such a man within the organization.

The mechanical engineer's department was handicapped by being too far away from the "firing line" or actual "seat of war." Its headquarters on most railroads are so far removed that it has no way of keeping closely in touch with the principal shops, except through correspondence. Not having responsible repre-


Master Mechanic
Asst. Master Mechanic
Superintendent of Shops
Traveling Foreman
Engine House Foreman Detroit
Engine House Foreman Adrian
Engine House Foreman Grand Rapids
Engine House Foreman Hillsdale
Engine House Foreman Other Points
Foreman Ft. Wayne Engine House
Foreman Englewood Engine House
Supervisor of Tests
Foreman Millard Engine House
Foreman Air Line Jct. Engine House
Asst. Foreman Air Line Jct. Engine House
Asst. Foreman Toledo Engine House
Night Foreman Elkhart R. H.
Engine Dispatcher Outlets
Asst. Foreman Elkhart Engine House
Foreman Mach. Shop
Foreman Heavy Repairs
Foreman Boiler Maker
Foreman Pass. House
Foreman Air Brake
Foreman Tanks
Foreman Boiler Maker
Head Foreman of Engines
Asst. Foreman Boiler Shop
Foreman Boiler Shop
Foreman Tin Copper & Pipe Shop
Foreman Tank & Light Sheet Iron Wk.
Engineers Foreman
Place Work Inspectors
Foreman Machine & Erecting Shop
Foreman Erecting Shop
Foreman Frame Gang
Foreman Truck-Spring and Brake
Foreman Motion Gang
Foreman Boiler Mounting Gang
Shop Instructor
Draftsman & Drawing Instructor
Foreman Paint Shop
Foreman Tender Shop
Foreman Smith Shop
Asst. Foreman Smith Shop
Foreman Pattern & Carpenter Shop
Asst. Foreman Carpenter
Foreman Foundry
Asst. Foreman Foundry
Foreman Brass Room
Foreman Tool Room
Foreman Rods and Motion Work
Foreman Gen. Mach. Work & Millwright
Millwright
Foreman Air Brake & Injectors Etc.
Machinists Mach. Appr.
Machinists Mach. Appr. Drill Pr. Man
Machinists Mach. Appr.
Machinists Mach. Appr. Mach. Helpers
Machinists Mach. Appr. Mach. Helpers
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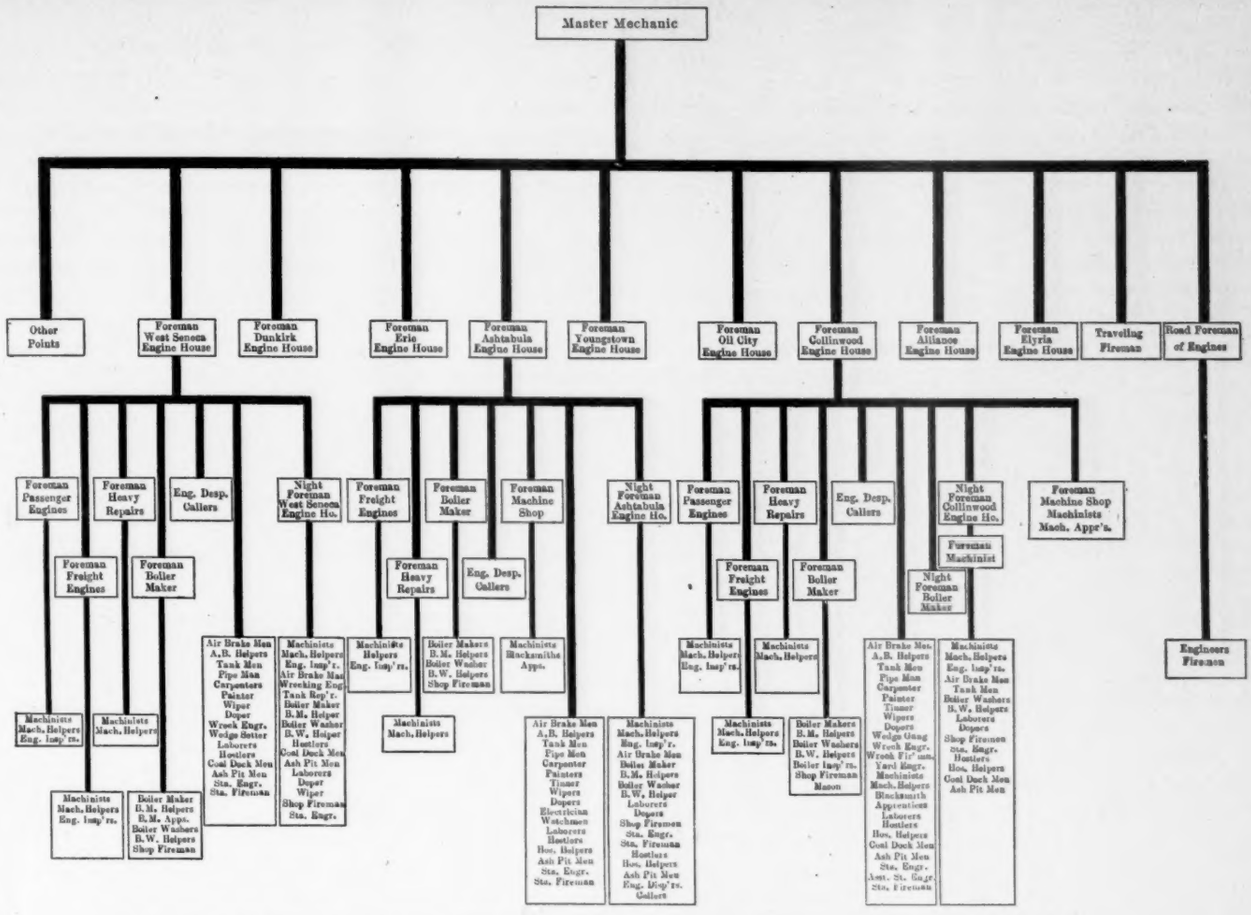

Master Mechanic
Other Points
Foreman West Seneca Engine House
Foreman Dunkirk Engine House
Foreman Erie Engine House
Foreman Ashtabula Engine House
Foreman Youngstown Engine House
Foreman Oil City Engine House
Foreman Collinwood Engine House
Foreman Alliance Engine House
Foreman Elyria Engine House
Traveling Fireman
Road Foreman of Engines
Foreman Passenger Engines
Foreman Heavy Repairs
Eng. Desp. Callers
Night Foreman West Seneca Engine Ho.
Foreman Freight Engines
Foreman Boiler Maker
Machinists Mach. Helpers Eng. Insp'rs.
Air Brake Men A.B. Helpers Tank Men Pipe Men Carpenters Painter Wiper Doper Wreck Engr. Wedge Setter Laborers Hostlers Coal Dock Men Ash Pit Men Sta. Engr. Sta. Fireman
Machinists Mach. Helpers Eng. Insp'rs. Air Brake Man Wrecking Engr. Tank Rep'r. Boiler Maker B.M. Helper Boiler Washer B.W. Helper Hostlers Coal Dock Men Ash Pit Men Laborers Doper Wiper Shop Fireman Sta. Engr.
Foreman Machine Shop
Night Foreman Ashtabula Engine Ho.
Machinists Blacksmiths Apps.
Boiler Makers B.M. Helpers Boiler Washer B.W. Helpers Shop Fireman
Air Brake Men A.B. Helpers Tank Men Pipe Men Carpenter Painters Timber Wipers Dopers Electrician Watchmen Laborers Hostlers Hos. Helpers Ash Pit Men Sta. Engr. Sta. Fireman
Machinists Mach. Helpers Eng. Insp'r. Air Brake Men Boiler Maker B.M. Helpers Boiler Washer B.W. Helper Laborers Dopers Shop Firemen Sta. Engr. Sta. Firemen Hostlers Hos. Helpers Ash Pit Men Eng. Insp'rs. Callers
Night Foreman Collinwood Engine Ho.
Foreman Machinist
Night Foreman Boiler Maker
Foreman Machine Shop Machinists Mach. Appr's.
Machinists Mach. Helpers Eng. Insp'rs.
Boiler Makers B.M. Helpers Boiler Washers B.W. Helpers Shop Fireman Mason
Air Brake Men A.B. Helpers Tank Men Pipe Men Carpenter Painter Timber Wipers Dopers Wedge Gang Wreck Engr. Wreck Firemen Yard Engr. Machinists Mach. Helpers Blacksmith Apprentices Laborers Hostlers Hos. Helpers Coal Dock Men Ash Pit Men Sta. Engr. Asst. St. Engr. Sta. Firemen
Machinists Mach. Helpers Eng. Insp'rs. Air Brake Men Tank Men Boiler Washers B.W. Helpers Laborers Dopers Shop Firemen Sta. Engr. Hostlers Hos. Helpers Coal Dock Men Ash Pit Men
Engineers Firemen

ORGANIZATION OF THE MASTER MECHANICS' OR LOCOMOTIVE OPERATING DEPARTMENT—EASTERN DIVISION.

culator. The calculator also receives all data as to broken or worn parts of locomotives and cars, analyzing the breakages and recommending improvements in design, where found advisable.

The information bureau is another important feature of this office. The drawing room is constantly in receipt of inquiries from the superintendent motive power's office, other departments, and from outside sources. Ordinarily this would take a large amount of time of men who have other important work to look after, and for this reason one man has been detailed to look up and obtain all information which is necessary to promptly and properly answer the inquiries.

The cost of all work done in the drawing office is accurately distributed; each job is given a number and each draftsman turns in a work slip every night showing the time he put in on each job during the day. A record is kept from which can be shown the actual cost of every job which is done. A time limit is set on each job and it is followed up to see that it is completed promptly on the scheduled time.

ORGANIZATION OF THE MASTER MECHANICS' OR LOCOMOTIVE OPERATING DEPARTMENT.

There are two master mechanics on the Lake Shore, one having charge of the territory east of Toledo, and the other having charge of Toledo and territory west. The general principles governing the form of organization are the same for each. The conditions are so different that, as may be seen, the charts differ more or less in detail. The master mechanic of the Eastern division has three large and important enginehouses under his jurisdiction, Buffalo (West Seneca), Ashtabula and Collinwood. A considerable amount of heavy running repairs are handled at Ashtabula and Collinwood, necessitating a machine shop in connection with each of these enginehouses.

On the Western division the master mechanic, in addition to the road work, has charge of the shops at Elkhart. The extensive district covered by this division makes it necessary for him to have an assistant. The general foreman at Air Line Junction is in charge of the enginehouses at Air Line Junction, Toledo, and several less important points. The general foreman at Elkhart has supervision over the enginehouse at Elkhart, and several less important points. The superintendent of shops is in direct charge of the Elkhart locomotive shops, the arrangement of the organization being clearly shown on the diagram.

Individual Efficiency Records.

The master mechanic has in his desk what is known as an efficiency card for every fireman and enginehouse employee. Eventually, he will have a card for every man under his charge. One of the fundamental principles of good organization is that the efficiency of each man be increased to the maximum. The efficiency of such men as work under piece work is automatically increased, but necessarily a large proportion of the men do not come under this head, so that a gauge must be placed on them, making it possible to determine their general efficiency and characteristics. By thus locating the poor and weak men they can be encouraged to improve, and if they do not show the necessary improvement, they may be dropped from the service.

It is to be feared that the foremen in many cases do not take a sufficient interest in studying the personalities of the men under them, or they may be burdened with routine work and do not find much opportunity for doing this. The efficiency card system not only makes it necessary for them to do this, but makes readily available a record of each man in the organization. The efficiency cards also enable the foremen to properly select men for promotion, as they must be observant and study the men under them closely, in order to properly fill out the cards.

A set of these cards is made out at intervals of about six

months. The road foreman of engines is furnished just enough cards so that there will be one for each man under him. He keeps no copy of his records and in this way, each time he makes out a new card it will be unprejudiced by any former report. That these efficiency cards are having a good effect is evidenced by the fact that it is not uncommon to have firemen inquire about them, showing that they realize the importance of their existence. They fully understand that the road foremen consult the enginehouse foremen and enginemen as to their performance and habits. This makes them much more eager to please and results in better service to the company. It also improves the standing of the road foremen of engines among the men and in the organization.

That the road foremen are studying the men closely is indicated by the fact that of thirty firemen who failed to pass the first and second year progressive examinations for different causes and were dropped from the service, the efficiency cards of all but two showed poor. The good effects of these efficiency cards will be more apparent when additional sets come in. The new efficiency cards are compared with the last set marked up and checked with all former cards by the master mechanic, and those men who have had a poor record and do not show improvement are called in and shown the cards; their weak points are indicated and they are encouraged to improve. The fireman cannot escape the fact that his record will go before the master mechanic as, under this system, the attention of the master mechanic is directed to the service of each individual.

An examination of these cards also brings out the fact that the personality of the road foremen of engines is reflected in them; that is, a road foreman of engines whose ideals may not be of the very highest will mark a fireman higher on certain things than would another with higher ideals. Of course, it is advisable to eliminate the matter of personality, and in so doing, it is necessary to educate the road foremen along certan lines, this being done by stated meetings between the master mechanic and the road foremen, and by quiet talks which the master mechanic has with them as occasion arises.

An interesting fact developed in connection with the selection of what is known as student instructors of firemen. These are capable first-class firemen who are selected to instruct the student, or new fireman. The student firemen are assigned to accompany the instructors on their runs in the performance of their regular duties. The road foremen of engines were asked to carefully select a certain number of these men. Their names were sent to the master mechanic who confirmed the appointments. He found, on examining the efficiency cards of these men, that in every case they had splendid cards.

The master mechanic received the following letter from the superintendent of motive power while the writer was talking to him about the efficiency cards:

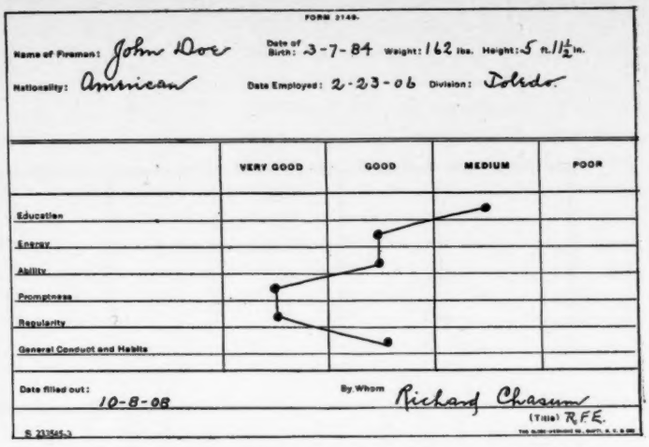
"Referring to your letter of the 2nd inst., relative to the dismissal of Mr. Blank. Will you kindly send me the latest efficiency card filled out for this man?"

Reference to the card showed that the man in question did not have a favorable card, as it was marked "Medium" on all points.

Two typical reports for firemen are reproduced for illustration: one showing a good card and the other a questionable one. If the man giving poor service has the right sort of stuff in him and the next report does not show an improvement, it should be possible to develop him along the proper lines by calling him in, showing him his card and pointing out the weak points.

Power Meetings.

Every three months a power meeting is held in the office of the master mechanic, at which the road foremen of engines, enginehouse foremen, shop superintendent and his assistant, and general foreman are present. The master mechanic has a card index before him showing the condition of each locomotive boiler when last reported (sample cards are shown in the accompanying illustrations). As the engine number is called out, the road foreman of engines under whose jurisdiction it comes, reports on the condition of machinery. If the conditions are such that it will be necessary to make repairs during the next three months, the class



INDIVIDUAL EFFICIENCY CARD FOR FIREMEN—A GOOD MAN.

of repairs and the month during which the engine will be shopped are decided upon.

A typical report of the result of a power meeting follows:

Engines that will need repairs during the month of—

Collinwood Locomotive Shop.

4594	E. H.—½ F.	4842	2 F.
4651	E. H. F.	4843	E. H. F.
4682	4 sheets.	5804	E. H. F.
4684	E. H. F.	5807	E. H. F.
4688	E. H. F. tires.	5818	E. H. F.
4720	2 F.	5822	E. H. F.
4728	E. H. F.	5841	E. H. F.
4729	E. H. F.	5843	I. F.
4733	E. H. F. tires	5871	2 F.
4800	2 F.	5875	2 F.
4801	2 F.	5940	1 F.
4805	E. H. F.	5973	1 F.
4813	E. H. F.	5975	1 F.
4815	2 F.	5993	2 F.
4816	2 F.	5996	2 F.
4820	2 F.	5842	1 F. 4 sheets.
4726	E. H. F. May want new F. sheet.		

Ashtabula.

4302	2 F. cut out.	4302	E. H.
4469	E. H. Tires.	4416	E. H. Tires.
4424	E. H. Tires.	4434	E. H. Tires.
5149	E. H. Tires.	4329	E. H. Tires.
5304	E. H. Dr. Boxes.		

Collinwood.

4309	E. H. Tires.	5134	E. H. ½ flues.
4429	E. H. Tires.	5119	E. H. Tires.
4538	E. H. Tires.	4310	E. H. Tires.

West Seneca.

4464	E. H. Tires.	4512	E. H. Tires.
4472	E. H. Tires.	4513	E. H. Tires.
4495	E. H. Tires.	4517	E. H. Tires.
4505	E. H. Tires.		

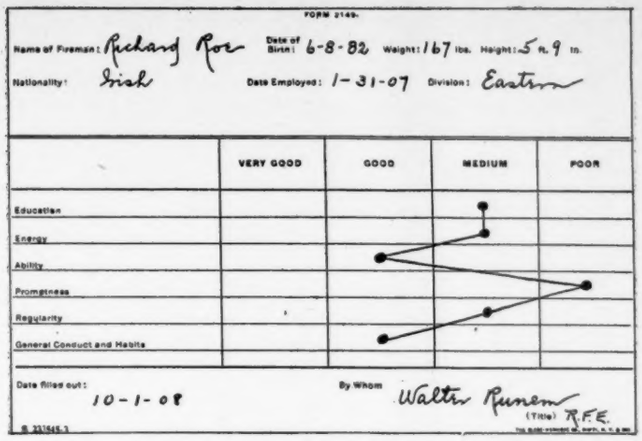
Classification of Locomotive Repairs.

Class 1—General repairs to machinery.
Class 2—Light repairs to machinery.
Class E. H.—Enginehouse repairs.
Class A—Accident repairs.
Class W.—Wreck repairs.
Letter "F" is suffixed to any of the above classes to indicate flues renewed.

It will be noted that the first part of the report shows the engines which will be taken to the shop, while the latter part shows those which are assigned to the different enginehouses for repairs.

Every week the master mechanic, shop superintendent and assistant shop superintendent, and such of the road foremen of engines as may be in the vicinity, hold a meeting and talk over the condition of engines which are to be shopped the following week. Having before them the power report they are enabled to select such engines as will keep the work well balanced.

When an engine requiring E. H. repairs is sent to the shop the



FORM 2149.

Name of Fireman: Richard Roe Date of Birth: 6-8-82 Weight: 167 lbs. Height: 5 ft. 9 in.

Nationality: Irish Date Employed: 1-31-07 Division: Eastern

	VERY GOOD	GOOD	MEDIUM	POOR
Education				
Energy				
Ability				
Promptness				
Regularity				
General Conduct and Habits				

Date filled out: 10-1-08 By Whom: Walter Runem (Title) R.F.E.

INDIVIDUAL EFFICIENCY CARD FOR FIREMEN—A QUESTIONABLE MAN.

master mechanic furnishes a work report; other work which the shop finds necessary, or thinks advisable, is referred to the master mechanic.

Enginehouse Work Reports.

An important improvement in the enginehouse organization has been effected by developing a system to properly take care of the reporting and checking of all work reported on locomotives. This includes a suitable file case for filing all finished and unfinished work cards, separately for each locomotive, so that, if desired, the name of the workman who made the repairs can easily and quickly be found. Thus if an engine failure takes place, due to improper repairs, or neglect at an enginehouse, the responsibility is easily located. In such cases, the enginehouse foreman is required to report the name of the man to the master mechanic and to make an exact note of what discipline, if any, was administered.

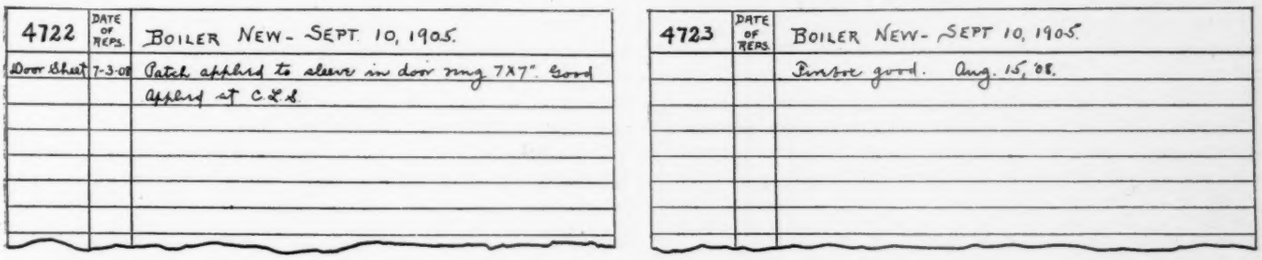
It is believed that this improved method of handling the enginehouse work reports is very largely responsible for the marked reduction in engine failures during the present year, as is shown on the accompanying diagram (page 462).

The actual figures showing the number of miles per engine failure in both freight and passenger service, the total number of miles made in each class of service, the number of failures and percentage of increase or decrease during each of the past four months, as compared with the record of the same four months for last year, are shown in the accompanying table.

An engine failure on the Lake Shore is defined as a delay to a train, due to any mechanical inefficiency, of three minutes in passenger and ten minutes in freight service. An engine failure is charged, although all of the lost time may be made up between terminals.

When an engineer comes in off his run he verbally reports the work which is necessary on the engine to a clerk at the work report office. The clerk writes the report in a work report book and the engineer reads it, and if correct, signs it. In this way the reports are always kept clean and legible. The clerk makes out the work slips from the report book on a form about 3 x 5 in., similar to the one shown in the illustration; a separate slip is made out for each job. When the work cards have been made out, the clerk marks the work report in the book O. K., with the figure 1 or 2 underneath, showing that the items have been copied on work slips; 1 indicates that the cards have been made out by the day clerk and 2 by the night clerk.

The cards are placed on the engine foreman's desk along with all incomplete work reports (work reported but not done when engine was last in the house) for that particular engine; these latter cards are taken from the incomplete pigeon-hole, of the engine in question, in the file case.*



4722	DATE OF REPS.	BOILER NEW - SEPT. 10, 1905.
Door Sheet	7-3-08	Patch applied to sleeve in door ring 7X7". Good
		Applied at C & L

4723	DATE OF REPS.	BOILER NEW - SEPT 10, 1905.
		Firebox good. Aug. 15, 08.

TYPICAL INDEX CARDS SHOWING THE CONDITION OF BOILERS. ENGINE NUMBER IN THE UPPER LEFT-HAND CORNER. CARDS ARE 4 X 6" IN SIZE.

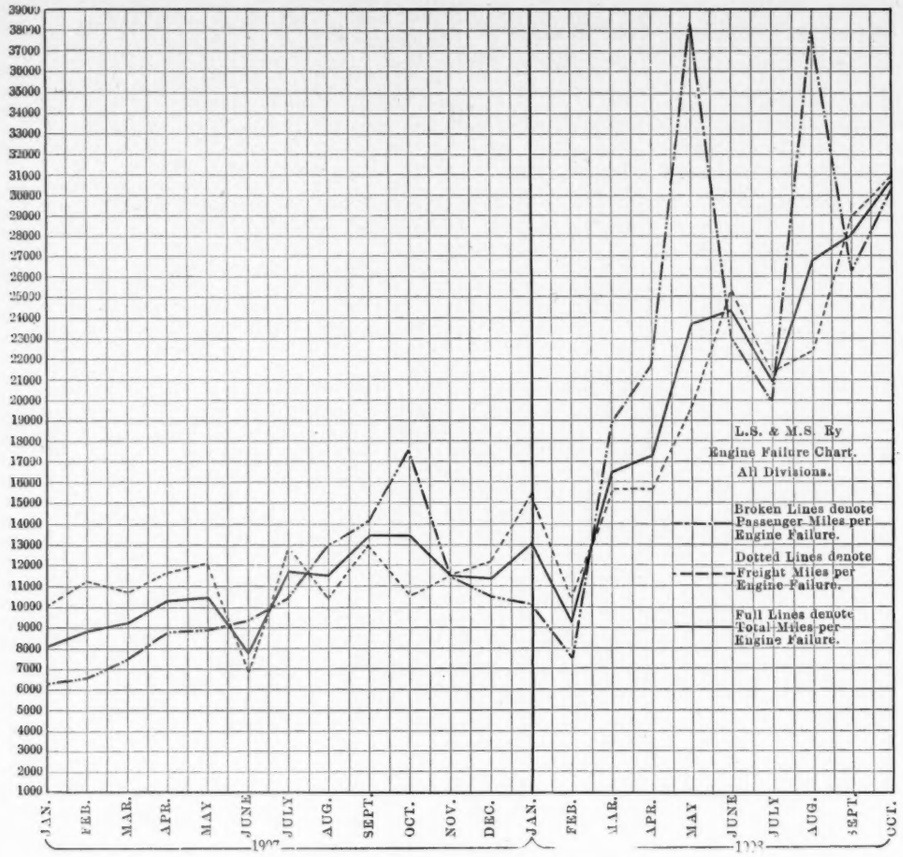
The passenger work cards are turned over to the passenger engine foreman and the freight and switch engine work cards are given to the freight engine foreman. These in turn distribute them to the various gang foremen or workmen, as the case may

* These file cases consist of pigeon holes 3½ in. wide and 8 in. high, one for each engine, sub-divided by tin slides so that the upper section, ¾ in. high, may be used for incomplete work cards, while the lower part, 2¼ in. high, is used for finished work reports.

These files are in the office of the clerk, in which no one is allowed to enter but the clerk and the engine-house foreman. The engineers' reports are dictated through a window. The hostler reports the engine numbers as soon as the engines are placed in the house or on storage track, so that the clerk can immediately place the incomplete work reports, if there are any, on the foreman's table.

			July.	August.	Sept.	Oct.
Miles run per Engine Failure	Passenger	08	19,948	37,939	26,191	30,153
	"	07	11,468	13,697	15,549	22,331
	Freight	08	21,308	22,525	29,048	30,896
	"	07	27,722	18,290	23,220	19,835
Number of Miles Run	Passenger	08	738,089	758,777	707,144	723,663
	"	07	756,877	794,418	761,923	781,569
	Freight	08	1,214,572	1,351,496	1,336,209	1,452,107
	"	07	1,580,138	1,591,232	1,578,980	1,765,327
Number of Engine Failures	Passenger	08	37	20	27	24
	"	07	66	58	49	35
	Freight	08	57	60	46	47
	"	07	69	87	68	89
Per Cent. Inc. or Dec. Miles Run per Engine Failure	Passenger	08	74	177	68	35
	Freight	08	23 Dec.	23	25	56

RECORD OF ENGINE FAILURES FOR JULY, AUGUST, SEPTEMBER AND OCTOBER, COMPARED FOR 1907 AND 1908.


L.S. & M.S. Ry
Engine Failure Chart.
All Divisions.
Broken Lines denote Passenger Miles per Engine Failure.
Dotted Lines denote Freight Miles per Engine Failure.
Full Lines denote Total Miles per Engine Failure.
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT.

ENGINE FAILURE CHART—ALL DIVISIONS.

be, and when the work is completed, or at the close of the work period, receive them back. The engine foremen distribute and receive the cards so that they may have an exact knowledge of all of the work reported and in order that they may promptly report the engines for service when the work is completed.

If any of the inspectors or foremen discover unreported work, a report is made out and handed to the clerk, who copies it in the work report book, and the card is handled the same as engineers' cards.

As soon as the work has been completed the workman signs and dates the cards on the face, in a place provided for that purpose, and returns them to the gang foreman. If, for any reason such as lack of material, too short time, or the engine not dumped, the work reported cannot be attended to before the engine goes out, the foreman having the work card will make a note on the back of it to that effect, signing his name and date. This incomplete work card is then filed in the incomplete pigeon-hole, under the number of the engine. When the engine returns to the enginehouse the incomplete cards are taken from the pigeon-hole and handled as new cards. If the work has been done at the other end of the run the card is signed and handled in the usual manner.

Where wheels have been reported to be examined and it has been decided that they need not be changed, the enginehouse and gang foremen jointly inspect the wheels before they are allowed to go out. If it is decided to let them run both men sign the back of the card to the effect that, in their opinion, the wheels are in condition to run.

A distinction is made between cards for work which, upon inspection by the gang foreman, is found to be in good condition and cards for work, which, although necessary to be done, could not be finished before the engine left the house. Cards of the first class refer to work which, in the judgment of the engine foreman, is in good condition and need not be done. These cards are signed on the face by the foreman, giving the date, and stating that the work reported was not necessary. They are then filed in the finished work pigeon-hole. Cards of the second class are for work to be attended to on the return of the engine and these should be signed and dated on the back with a brief ex-

NEW YORK CENTRAL LINES

FORM 2668. S. 9657. 200m. 8-08. (GES 85112)

LOCOMOTIVE WORK CARD. No.....

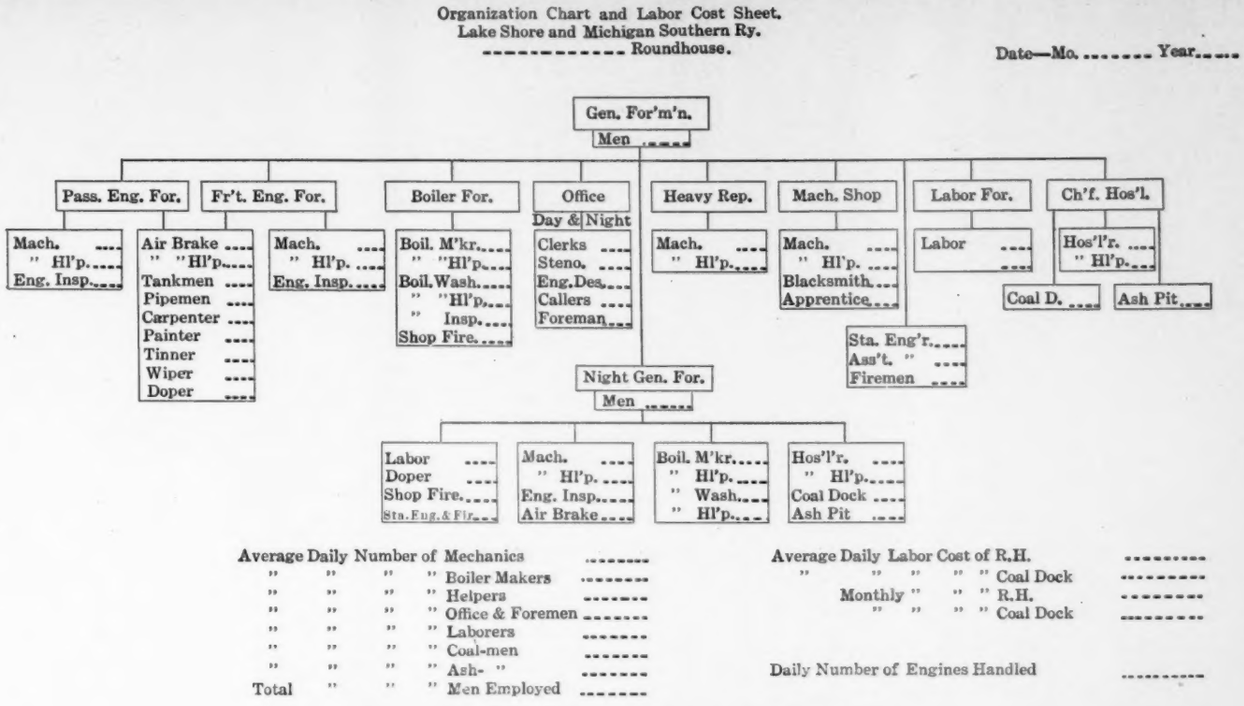
Eng. No.	Eng'r.....or Insp.....	Place and Date

Work Performed by	Date

ENGINEHOUSE WORK REPORT CARD.

REMARKS—Why Not Done	Foreman	Date

BACK OF ENGINEHOUSE WORK REPORT CARD.

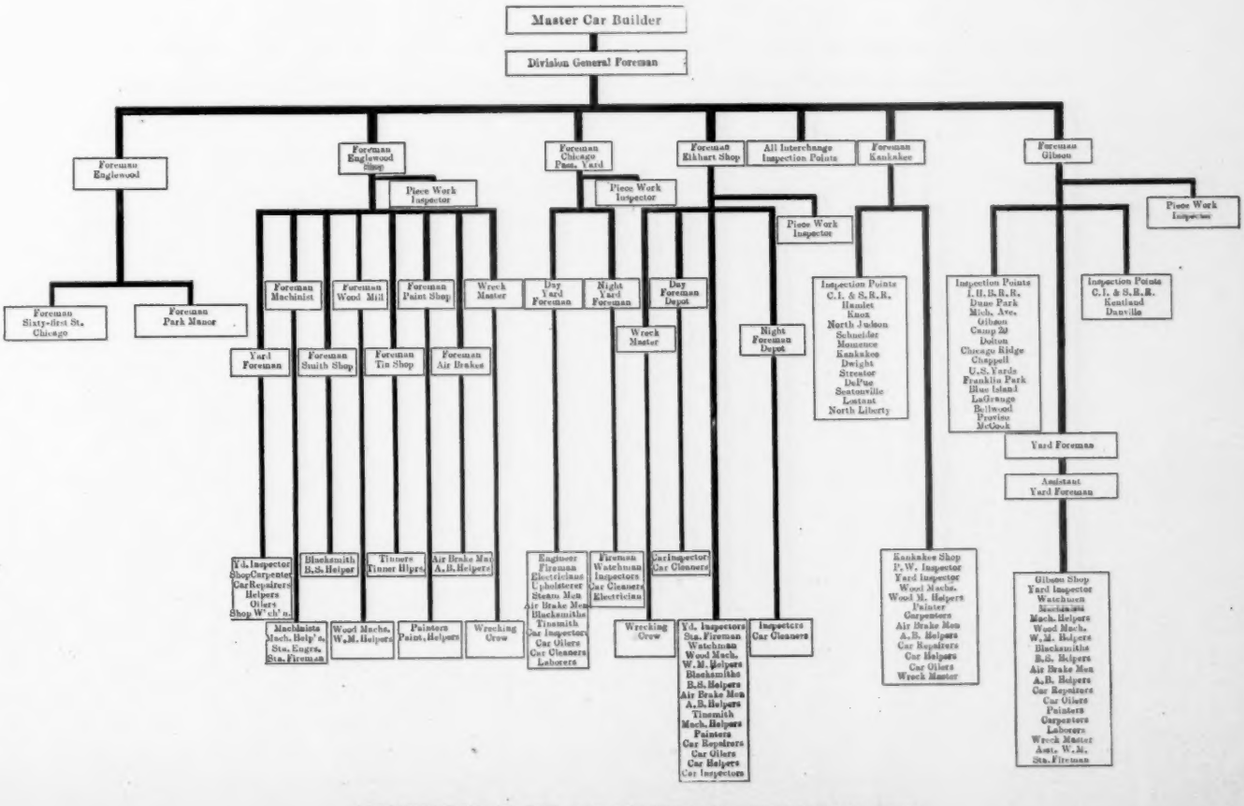

Organization Chart and Labor Cost Sheet.
Lake Shore and Michigan Southern Ry.
---------- Roundhouse.
Date—Mo. ..... Year.....
Gen. For'm'n.
Men .....
Pass. Eng. For.
Fr't. Eng. For.
Boiler For.
Office
Day & Night
Heavy Rep.
Mach. Shop
Labor For.
Ch'f. Hos'l.
Mach. .... " Hl'p. ..... Eng. Insp. .....
Air Brake .... " "Hl'p. .... Tankmen .... Pipemen .... Carpenter .... Painter .... Tinner .... Wiper .... Doper ....
Mach. .... " Hl'p. .... Eng. Insp. ....
Boil. M'kr. ..... " "Hl'p. .... Boil. Wash. ..... " "Hl'p. .... " Insp. .... Shop Fire. .....
Clerks .... Steno. .... Eng. Des. .... Callers .... Foreman ....
Mach. .... " Hl'p. .....
Mach. .... " Hl'p. .... Blacksmith .... Apprentice ....
Labor .....
Hos'l'r. .... " Hl'p. ....
Coal D. .....
Ash Pit .....
Sta. Eng'r. ..... Ass't. " .... Firemen .....
Night Gen. For.
Men .....
Labor .... Doper .... Shop Fire. .... Sta. Eng. & Fir. ....
Mach. .... " Hl'p. .... Eng. Insp. .... Air Brake ....
Boil. M'kr. ..... " Hl'p. .... " Wash. .... " Hl'p. ....
Hos'l'r. .... " Hl'p. .... Coal Dock .... Ash Pit ....
Average Daily Number of Mechanics .....
" " " " Boiler Makers .....
" " " " Helpers .....
" " " " Office & Foremen .....
" " " " Laborers .....
" " " " Coal-men .....
" " " " Ash- " .....
Total " " " Men Employed .....
Average Daily Labor Cost of R.H. .....
" " " " " Coal Dock .....
Monthly " " " R.H. .....
" " " " Coal Dock .....
Daily Number of Engines Handled .....

ENGINEHOUSE ORGANIZATION CHART AND LABOR COST SHEET.

planation of why the work was not done before the engine left the house.

The gang foreman returns all completed cards when the work is finished. The incomplete cards are turned in when the engine leaves the house, or at the close of the work periods. Incomplete cards for engines still in the house are turned over to the incoming gang foreman at the work office. At the close of the month all finished work cards are tied up in bunches, according to the engine numbers, and sent to the master mechanic's office, where they are filed.

Occasionally some one is detailed from the master mechanic's office to visit the enginehouses and check up the file cases with the work books. The checking of these cases show that very few of the cards are lost or misplaced. This is especially true, since the men have learned that missing cards will be traced and an explanation required. An important advantage of the work card file case is that it enables the enginehouse foreman to promptly and intelligently regulate his forces. The unfinished work, being always in sight in the case, can be checked quickly and enables him to determine whether each class of work is ahead or behind.


Master Car Builder
Division General Foreman
Foreman Englewood
Foreman Englewood Shop
Foreman Chicago Pass. Yard
Foreman Elkhart Shop
All Interchange Inspection Points
Foreman Kankakee
Foreman Gibson
Piece Work Inspector
Foreman Sixty-first St. Chicago
Foreman Park Manor
Foreman Machinist
Foreman Wood Mill
Foreman Paint Shop
Wreck Master
Day Yard Foreman
Night Yard Foreman
Day Foreman Depot
Night Foreman Depot
Inspection Points C. I. & S. R. R. Hamlet Knox North Judson Schneider Monence Kankakee Dwight Streator DePue Seatonville Lostant North Liberty
Inspection Points I. H. B. R. R. Dune Park Mich. Ave. Gibson Camp 20 Dolton Chicago Ridge Chappell U. S. Yards Franklin Park Blue Island LaGrange Bellwood Proviso McCook
Inspection Points C. I. & S. R. R. Kentland Danville
Yard Foreman
Assistant Yard Foreman
Yard Foreman
Foreman Smith Shop
Foreman Tin Shop
Foreman Air Brakes
Yd. Inspector Shop Carpenters Car Repairers Helpers Oilers Shop W'ch'n.
Blacksmith B.S. Helper
Tinners Tinner Hlprs.
Air Brake Men A.B. Helpers
Machinists Mach. Help'rs Sta. Engrs. Sta. Firemen
Wood Mechs. W.M. Helpers
Painters Paint. Helpers
Wrecking Crew
Engineer Fireman Electricians Upholsterers Steno. Men Air Brake Men Blacksmiths Tinsmith Car Inspector Car Oilers Car Cleaners Laborers
Fireman Watchman Inspectors Car Cleaners Electricians
Car Inspector Car Cleaners
Wrecking Crew
Yd. Inspectors Sta. Fireman Watchman Wood Mech. W.M. Helpers Blacksmiths B.S. Helpers Air Brake Men A.B. Helpers Tinsmith Mech. Helpers Painters Car Repairers Car Oilers Car Helpers Car Inspectors
Inspectors Car Cleaners
Kankakee Shop P.W. Inspector Yard Inspector Wood Mechs. Wood M. Helpers Painter Carpenters Air Brake Men A.B. Helpers Car Repairers Car Helpers Car Oilers Wreck Master
Gibson Shop Yard Inspector Watchmen Mechanics Mech. Helpers Wood Mech. W.M. Helpers Blacksmiths B.S. Helpers Air Brake Men A.B. Helpers Car Repairers Car Oilers Painters Carpenters Laborers Wreck Master Asst. W.M. Sta. Fireman

ORGANIZATION OF THE CAR DEPARTMENT—WESTERN DIVISION.

Organization Chart and Labor Cost Sheet.

Each month an organization chart and labor cost sheet, similar to the one shown in the illustration, is made out by each enginehouse foreman and forwarded to the master mechanic's office. This sheet shows the number of men engaged in each class of work, both day and night; the average daily cost of operating the enginehouse, also the coal dock; and the average number of engines handled daily. It is thus possible to compare the operation and efficiency of the enginehouses month by month.

If it is found by examination of the work report case that one line of work is falling behind, it may be seen at a glance just how many men are in the gang and the necessity for adjustment. The sheet not only gives the master mechanic valuable information, by which he can check the operation of each enginehouse, but the general foreman, and the foremen who assist him in compiling it are encouraged to observe and study the conditions more closely and to handle their forces to better advantage.

Car Department Organization.

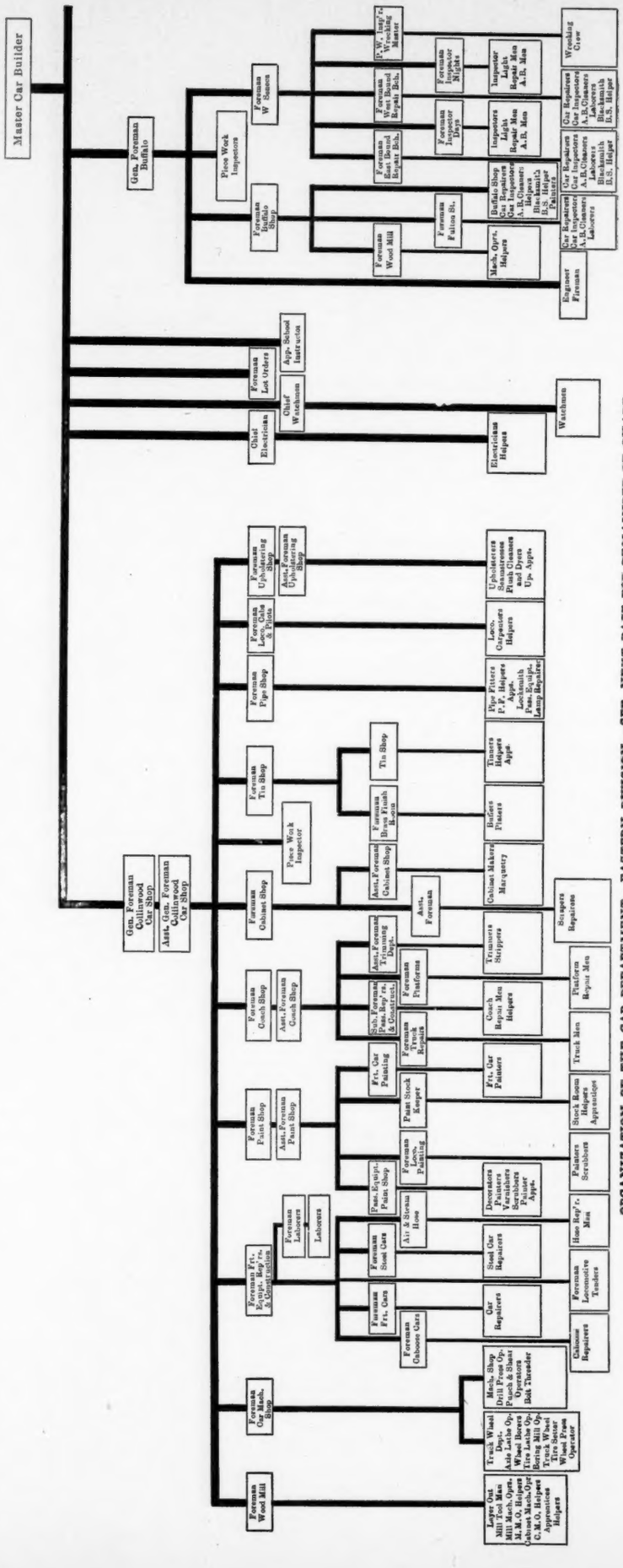
The car department is divided at Toledo: Toledo and points east are under the jurisdiction of the master car builder at Collinwood, and all points west of Toledo are under the jurisdiction of the master car builder at Englewood. The master car builder of the Eastern division has under his jurisdiction car shops at Collinwood, Air Line Junction, Ashtabula and Buffalo, in addition to repair yards at several other interchange points.

The organization of the car shop at Collinwood is clearly indicated in the diagram. The foreman of freight equipment repairs and construction has under him a foreman in charge of caboose repairs, foreman of wooden freight cars and a foreman of steel cars; the foreman of the paint shop has an assistant and the work is separated into four departments, including passenger equipment paint shop, freight car painting, locomotive painting and the paint storekeeper. While the foreman of locomotive painting is a member of the car department organization he, of course, is in intimate touch with the foreman of the locomotive shop and co-operates with him closely. The same thing is also true of the foreman of locomotive cabs and pilots, who reports directly to the general foreman of the car shop. The chief electrician, chief watchman, foreman of lot orders and apprentice school instructor at Collinwood are shown reporting direct to the master car builder; these men are also shown on the diagram of the superintendent of the Collinwood locomotive shops, and are responsible for work in both departments.

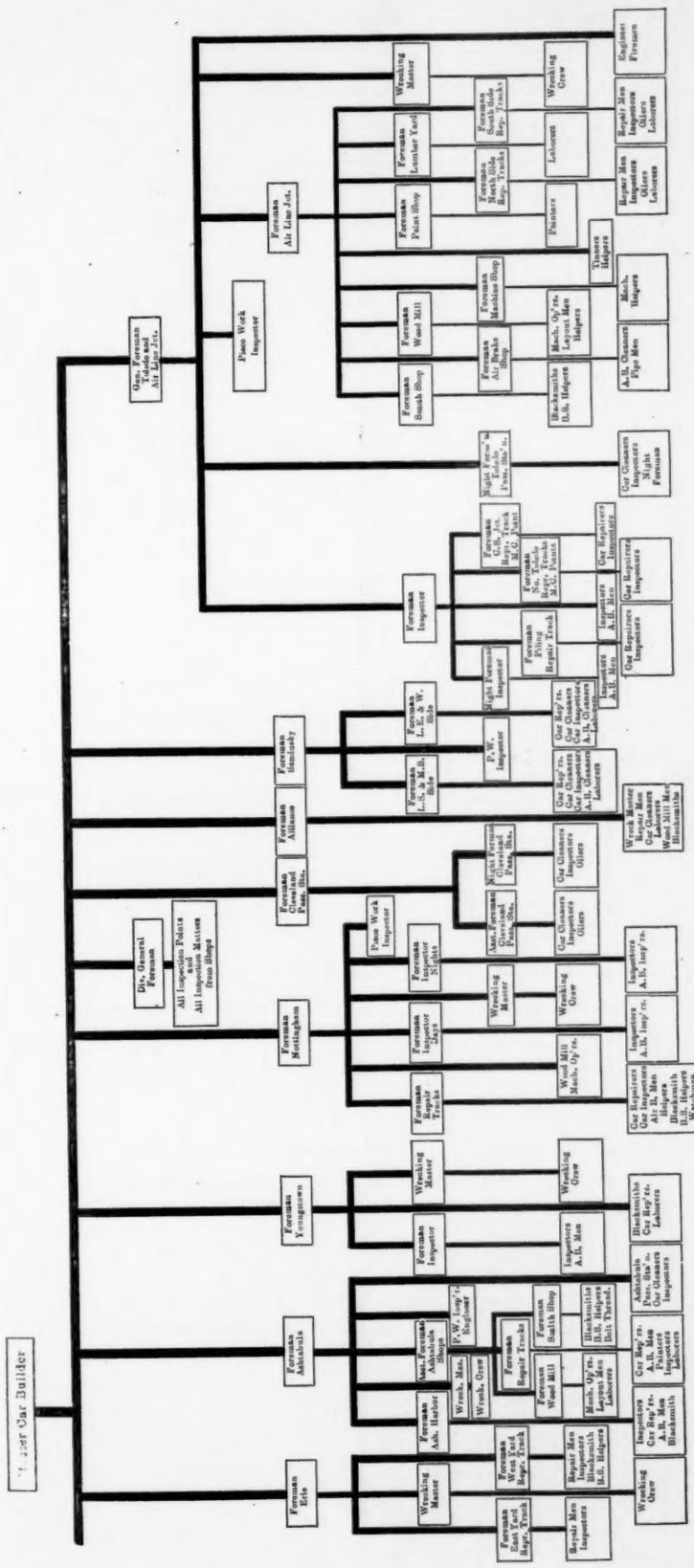
Little comment need be made on the rest of the organization, as it is very clearly shown. There is a division general foreman who reports to the master car builder and has charge of all inspection points and inspection matters at the shops.

The master car builder of the Western division has shops at Englewood and Elkhart. There are a number of inspection points and repair points on this division and these are taken care of by the division general foreman.

Efficiency cards are made out by the various foremen to cover every employee in the car department. These cards are the same as used for


Master Car Builder
Gen. Foreman Buffalo
Gen. Foreman Collinwood Car Shop
Asst. Gen. Foreman Collinwood Car Shop
Gen. Foreman Englewood Car Shop
Asst. Gen. Foreman Englewood Car Shop
Piece Work Inspectors
Foreman W. Spans
Foreman Buffalo Shop
Foreman Wood Mill
Foreman Fulton St.
Foreman Wreck Repair Boh.
Foreman Inspector Days
Foreman Inspector Nights
Inspectors Lights Repair Men A.B. Men
Wrecking Crew
Car Repairers Car Inspectors A.B. Cleaners Laborers Blacksmith B.S. Helper
Boiler Shop Car Repairers Car Inspectors A.B. Cleaners Laborers Blacksmith B.S. Helper Painters
Mech. Oprs. Helpers
Engineer Firemen
Foreman Lot Orders
Chief Electrician
Chief Watchman
Apprentice School Instruction
Electricians Helpers
Watchmen
Foreman Upholstering Shop
Asst. Foreman Upholstering Shop
Upholsterers Seamstresses Plush Cleaners and Dyers Upholstering Apprentices
Foreman Loco. Cabs & Pilots
Loco. Carpenters Helpers
Foreman Pipe Shop
Pipe Fitters P.F. Helpers Apprentices Locksmith Helper Blacksmith Helper Lamp Repairer
Foreman Tin Shop
Tin Shop
Tinners Helpers Apprentices
Foreman Brass Finish Room
Buffers Platers
Foreman Cabinet Shop
Asst. Foreman Cabinet Shop
Cabinet Makers Marqueters
Asst. Foreman
Foreman Trimming Dept.
Trimmers Scrapers
Scrapers Repairers
Foreman Coach Shop
Asst. Foreman Coach Shop
Sub. Foreman Pass. Rep'rs. & Constructors
Foreman Platforms
Platform Repair Men
Foreman Truck Repairs
Coach Repair Men Helpers
Foreman Paint Shop
Asst. Foreman Paint Shop
Frt. Car Painting
Paint Stock Keeper
Frt. Car Painters
Truck Men
Stock Room Helpers Apprentices
Pass. Equipt. Paint Shop
Foreman Loco. Painting
Painters Scrubbers
Decorators Painters Varnishers Sign Painter Apps.
Foreman Frt. Equipt. Rep'rs. & Constructors
Foreman Laborers
Laborers
Air & Steam Hose
Hose Rep'r. Men
Foreman Steel Cars
Steel Car Repairers
Foreman Locomotive Tenders
Foreman Frt. Cars
Car Repairers
Foreman Caboose Cars
Caboose Repairers
Mech. Shop Drill Press Op. Punch & Shear Operators Bolt Threader
Foreman Car Mach. Shop
Track Wheel Dept. Axle Lathe Op. Wheel Borer Tire Lathe Op. Boring Mill Op. Truck Wheel Fit Setter Wheel Press Operator
Foreman Wood Mill
Leger Out Mill Tool Men Mill Mach. Oprs. M. & O. Helpers Cabinet Makers C. M. O. Helpers Apprentices Helpers

ORGANIZATION OF THE CAR DEPARTMENT—EASTERN DIVISION—SEE NEXT PAGE FOR REMAINDER OF CHART.



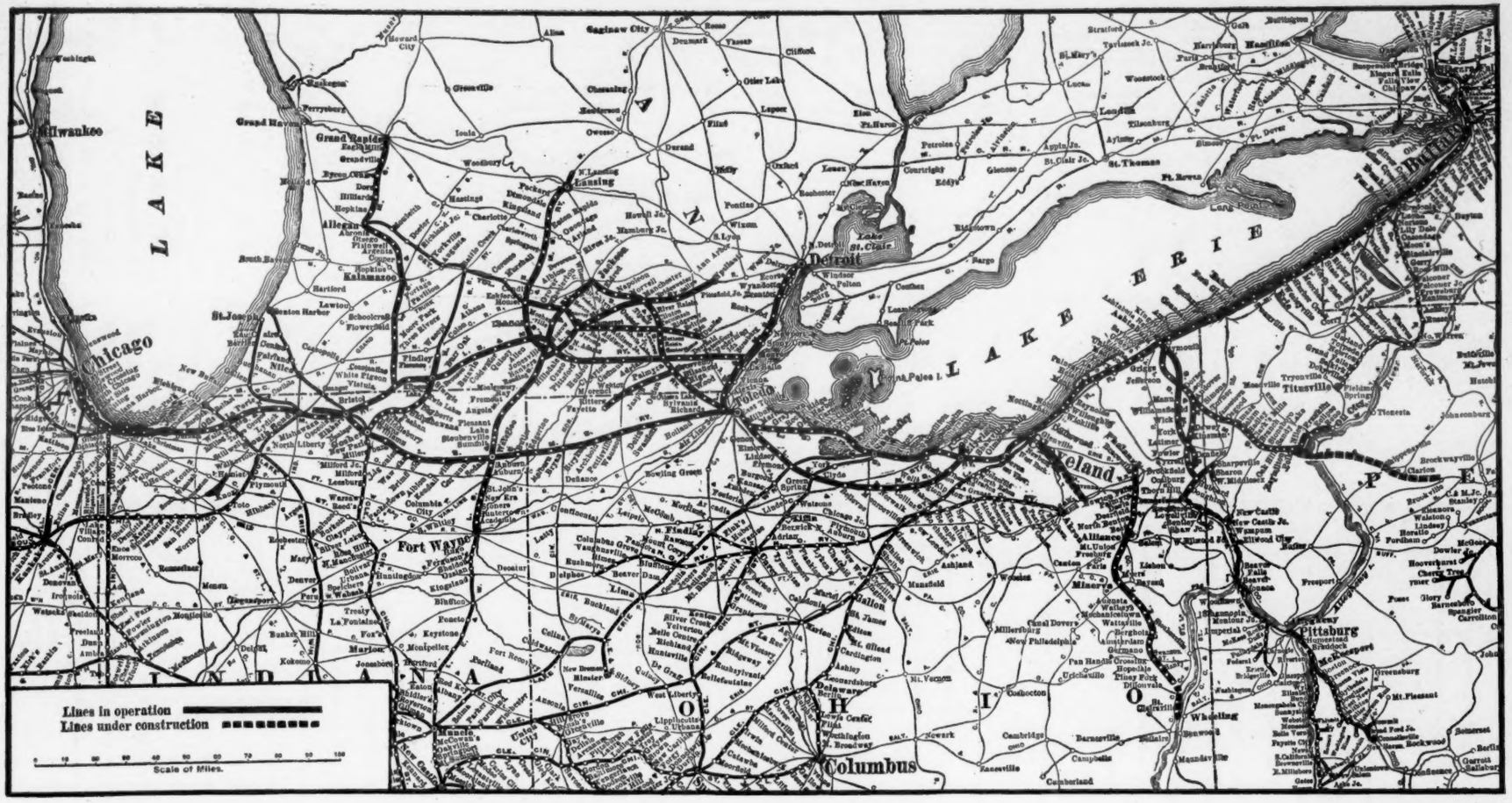
ORGANIZATION OF THE CAR DEPARTMENT—EASTERN DIVISION—SEE OPPOSITE PAGE FOR REMAINDER OF CHART.

Abstract from Passenger Car Failure Reports Showing Number of Failures and Miles Run per Failure, for Four Months This Year as Compared with a Year Ago.

		July.	August.	September.	October.
Miles run per passenger car failure	08	136,981	121,603	124,467	85,908
	07	90,484	62,595	49,277	50,369
Total number passenger car miles	08	4,794,335	4,864,117	4,720,435	4,553,125
	07	4,433,717	4,444,255	4,207,250	4,231,025
Number of passenger car failures	08	35	40	38	53
	07	49	71	82	81
Percentage of increase, miles run per car failure	08	51.3	94.2	152.5	70.5

all shop and enginehouse employees, as described in detail on pages 459 and 468.

A classified passenger car failure report is made showing all delays to trains of three minutes or more caused by any defect on a car in a passenger train. Due to the close study and analysis of these reports and the keying up of the entire organization, a remarkable improvement has been made during the past year, as may be seen from the accompanying table, which shows the miles run per passenger car failure, the total number of passenger car miles, the number of passenger car failures, and the percentage of increase in the miles per passenger car failure for July, August, September and October of this year, as compared to the same four months of last year.



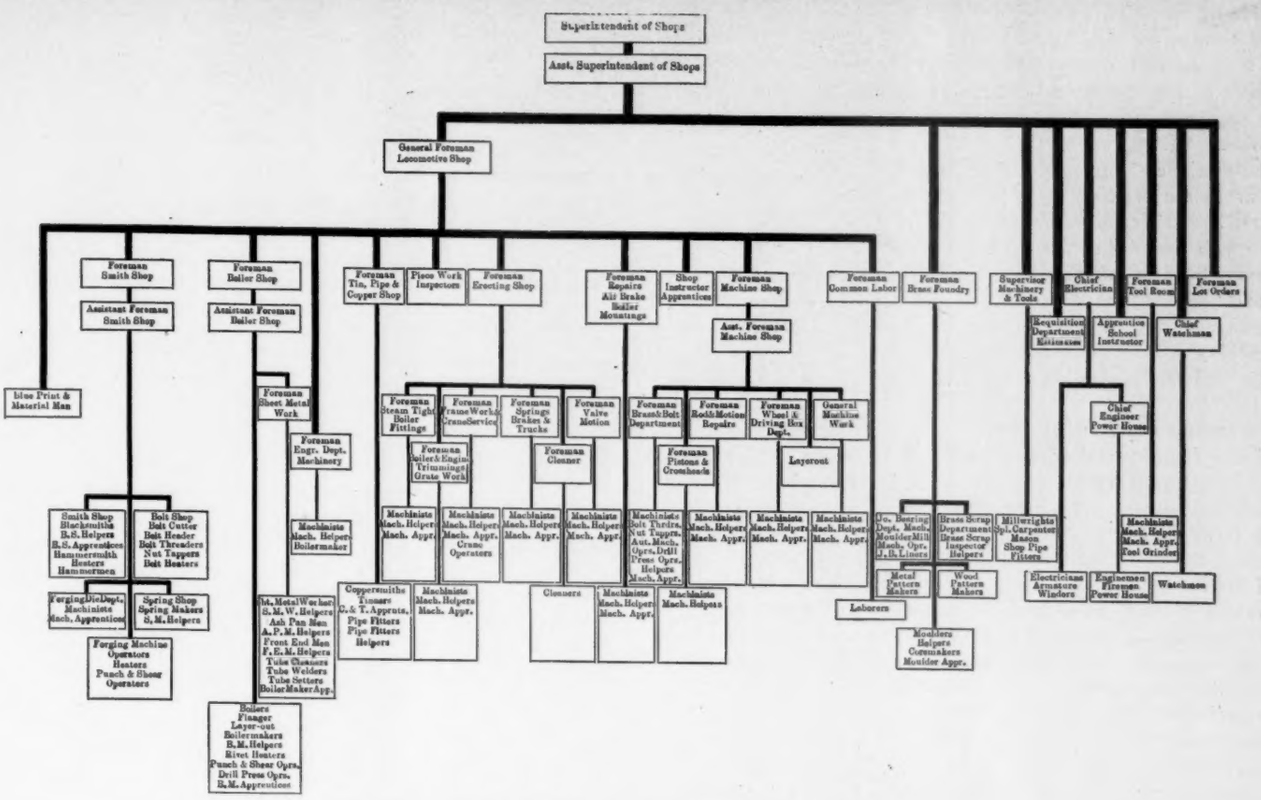
MAP SHOWING THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

The Lake Shore not only forms a splendidly equipped trunk line between Buffalo and Chicago, but its branches lie squarely in the main currents of freight movement. The main line between Buffalo and Chicago consists of 540.04 miles, having 311.75 miles of second track, 160.84 miles of third track, 117.69 miles of fourth track and 687.45 miles of siding. The total number of miles operated is 1,520.35, including branches, proprietary lines owned wholly by the company, and leased lines.

The average number of tons of revenue-earning freight carried per train mile during 1906 was 624.5, having increased to this from 318.5 in 1895. Reference to the Interstate Commerce Commission statistics for 1906 shows that the average for all the roads in the country during that year was 344.39 and the average for Group III, in which the Lake Shore is included, was 426.33. This exceptionally heavy train load indicates that the road must be in splendid physical condition and that its equipment must be first-class. The above figures are the more remarkable when it is considered that the main line between Chicago and Buffalo is 540 miles long, or only about 35½ per cent. of the mileage operated.

The passenger earnings for 1906 amounted to $8,715,702 and the earnings from mail and express, $3,390,004. The density of passenger traffic—the passengers carried one mile per mile of road—amounted to 277,840. The Interstate Commerce Commission statistics show that during 1906 this figure for all the roads in the country amounted to 114,529, while for Group III, in which the Lake Shore is included, it amounted to 126,794. The average number of passengers per train mile was 57.38 and the average number of miles one passenger was carried 58.70. For the entire country these figures amounted to 52.5 and 31.54, and in Group III to 45 and 38.64 respectively.

The rolling stock owned and leased by the company, as shown by the last annual report, amounted to 830 locomotives, 640 passenger cars, 40,891 freight cars and 1,673 company service cars.


Superintendent of Shops
Asst. Superintendent of Shops
General Foreman Locomotive Shop
Foreman Smith Shop
Assistant Foreman Smith Shop
Foreman Boiler Shop
Assistant Foreman Boiler Shop
Foreman Tin, Pipe & Copper Shop
Piece Work Inspectors
Foreman Erecting Shop
Foreman Repairs Air Brake Boiler Mountings
Shop Instructor Apprentices
Foreman Machine Shop
Asst. Foreman Machine Shop
Foreman Common Labor
Foreman Brass Foundry
Supervisor Machinery & Tools
Chief Electrician
Foreman Tool Room
Foreman Lot Orders
Requisition Department Estimates
Apprentice School Instructor
Chief Watchman
Chief Engineer Power House
blue Print & Material Man
Foreman Sheet Metal Work
Foreman Engr. Dept. Machinery
Foreman Steam Tight Boiler Fittings
Foreman Frame Work & Crane Service
Foreman Springs Brakes & Trucks
Foreman Valve Motion
Foreman Brass & Bolt Department
Foreman Rod & Motion Repairs
Foreman Wheel & Driving Box Dept.
General Machine Work
Foreman Boiler & Engine Trimmings & Grate Work
Foreman Cleaner
Foreman Pistons & Crossheads
Layout
Smith Shop Blacksmiths B.S. Helpers B.S. Apprentices Hammersmith Hosters Hammermen
Bolt Shop Bolt Cutter Bolt Header Bolt Threaders Nut Tappers Bolt Heaters
Machinists Mach. Helpers Boilermaker
Machinists Mach. Helper Mach. Appr.
Machinists Mach. Helpers Mach. Appr. Crane Operators
Machinists Mach. Helpers Mach. Appr.
Machinists Mach. Helpers Mach. Appr.
Machinists Bolt Thrers. Nut Tappers Aut. Mach. Opers. Drill Press Opers. Helpers Mach. Appr.
Machinists Mach. Helpers Mach. Appr.
Machinists Mach. Helpers Mach. Appr.
Machinists Mach. Helper Mach. Appr.
Jo. Boring Dept. Mach. Moulder Mill Mach. Opr. L. & B. Liners
Brass Scrap Department Brass Scrap Inspector Helpers
Millwrights Spl. Carpenter Mason Shop Pipe Fitters
Machinists Mach. Helper Mach. Appr. Tool Grinder
Forging Die Dept. Machinists Mach. Apprentices
Spring Shop Spring Makers S. M. Helpers
Forging Machine Operators Heaters Punch & Shear Operators
Bl. Metal Worker S.M.W. Helpers Ash Pan Men A.P.M. Helpers Front End Men F.E.M. Helpers Tube Cleaners Tube Welders Tube Setters Boiler Maker App.
Coppersmiths Tinners G. & T. Apprens. Pipe Fitters Pipe Fitters Helpers
Machinists Mach. Helpers Mach. Appr.
Cleaners
Machinists Mach. Helpers Mach. Appr.
Machinists Mach. Helpers
Metal Pattern Makers
Wood Pattern Makers
Electricians Armature Winders
Engineers Firemen Power House
Watchmen
Laborers
Moulders Helpers Coremakers Moulder Appr.
Boilers Flanger Layer-out Boilermakers B.M. Helpers Rivet Heaters Punch & Shear Oprs. Drill Press Oprs. B.M. Apprentices

ORGANIZATION OF THE COLLINWOOD LOCOMOTIVE SHOPS.

COLLINWOOD LOCOMOTIVE SHOPS.

Referring to the Collinwood locomotive shop organization diagram it will be seen that the direct line of authority extends from the superintendent of shops to the assistant superintendent of shops and to the various heads of departments.

This line of authority is carefully followed; all orders to the shops are issued over the signature of the assistant superintendent of shops, though many of these orders may be dictated by the superintendent of shops. All communications are addressed to the immediate superior, *i.e.*, the erecting or machine foreman will address the general foreman and the general foreman the assistant superintendent of shops. As the superintendent of shops and assistant superintendent of shops have adjoining offices and the same chief clerk, it is not necessary for them to write letters to one another.

It will be noted that the general foreman's organization consists practically of those responsible for locomotive output, except for the car department blacksmith shop, engineering department machinery repairs and the manufacturing departments in the machine and the tin department.

The blue print and material man is an experienced draftsman and shop man. The blueprints in this department are filed with the same system as in the mechanical engineer's office and are issued on shop checks. The blue print man also assists the general foreman in ordering and checking standard material, working in harmony with the shop chief draftsman of the mechanical engineer's staff.

The foreman of the smith shop, with his assistant, is in charge of the blacksmith shop, the bolt making department, spring department and forging machines. They are also in charge of the forging die department, including the making and repairing of dies for the forging machines, bulldozers and bolt headers. The general foreman of the locomotive shop is the employing officer of the foreman of the smith shop, although the smith shop foreman is responsible to the general foreman of the car department for the satisfactory performance of car department blacksmith work and will recognize regular orders for car department repairs direct, without coming through the general foreman of the locomotive shop.

In like manner the general foreman of the locomotive shop is responsible for locomotive painting, although the foreman painter of the master car builder's organization is the employing officer of the locomotive shop foreman of painting.

The foreman of engineering department machinery is responsible for repairs to steam shovels, stationary boilers, pile drivers, wreckers, etc.

The foreman of the tin, pipe and copper shop and the piecework inspectors report direct to the general foreman.

In studying the diagram of the foreman of the erecting shop, it will be seen that his organization is arranged to correspond with the organization in the machine shop; each gang foreman is in charge of a certain class of repairs on locomotives. To illustrate, the foreman of frame work and crane service is responsible for this work on all engines on the erecting floor. All work performed by the main crane is under his direction, thus gaining the greatest efficiency from the crane. In the fitting of shoes and wedges it is not possible for these parts for three engines to be delivered to the machine shop foreman at the same hour of the day, as these parts on each engine are repaired by the same men and in the order scheduled.

The stripping of locomotives is performed by specialists under the direction of the regular gang foreman. This makes each gang foreman directly responsible for the unnecessary stripping or taking down of parts not called for on the work report, or for the breaking of parts while stripping. While the work is being stripped it is placed in metal baskets which are taken to the lye vat, cleaned and distributed to the proper departments for repairs.

At the center of erecting shop a special bulletin board is placed to show engines scheduled out during the current week by days. Where two or more engines are out the same day they go in the order marked.

The foreman of the air brake department reports to the general foreman. This department repairs all boiler mountings, including steam gauges, injectors, lubricators, etc., for Collinwood locomotive shop; also similar parts for the enginehouses under the master mechanic's jurisdiction.

The shop instructor of apprentices is a practical mechanic and

capable of operating all machines in the machine shop. He devotes most of his time to the instruction of machine apprentices. The time devoted to any one individual is determined by the experience of the apprentice, and the importance of the operation. The shop instructor also keeps a complete record of each apprentice.

The machine shop organization, as stated before, is arranged similar to the erecting shop, and will be understood from the diagram. Each gang or department is provided with a bulletin board with the days of the week in the first or left-hand vertical column. In the column to the right is shown the engine numbers, the parts of which must be repaired and delivered to the erecting shop on each day. When the parts are not delivered on time, responsibility for the delay is placed.

The foreman of common labor has charge of all common laborers.

The superintendent of the brass foundry has supervision over the brass foundry and pattern makers. All waste products of white metals, foundry cinders, skimmings, brass turnings, etc., are turned over to this department, where the good material is separated from the waste. The superintendent of the brass foundry is also in charge of the journal bearing department. All second-hand journal bearings are shipped to this department; the linings are removed, the bearings carefully inspected and those that pass are re-lined and again placed in service. The brass scrap is thoroughly inspected and material that is good for further use is sent to the machine shop, repaired and again placed in service. All white metals are mixed and properly prepared and samples are taken and analyzed by the chemist and engineer of tests to see that they conform to the specifications.

The supervisor of machinery and tools is responsible for repairs to all the machinery and to the shop piping in the Collinwood locomotive and car departments.

The chief electrician is in charge of electric power and lighting of the entire Collinwood plant.

The apprentice school instructor is responsible for the instruction of apprentices in the school room.

The foreman of the tool room is in charge of the tool room and small tools throughout the plant, including air motors, air hammers; also the grinding and supplying of all tools for machines.

The chief watchman is responsible for the proper protection and patrolling of the Collinwood locomotive and car department buildings and grounds, also the enginehouse and adjacent territory.

ORGANIZATION CHARTS.

The making of the organization charts, considered in the previous sections of this article, often discloses a weakness in the form of organization, making it possible to simplify it and eliminate any conflict of authority. The charts are not of prime importance, but they are helpful because they show at a glance the jurisdiction of any official or foreman, and the proper route by which matters are to be taken up with him.

The important feature of any organization is to have a definite and exact understanding of the duties of every man in it and to know just how far the duties of each extend.

The making of these diagrams will direct attention to the logical arrangements; after all, the form of organization should be based strictly on common sense, the object being to accomplish the best results with the least possible expenditure of energy and the smallest amount of red tape.

EFFICIENCY CARD SYSTEM.

The efficiency card system used in connection with the shop and enginehouse employees is somewhat more elaborate than that used in the master mechanic's department for the locomotive firemen, as described on page 459. Several typical efficiency cards are shown in the illustrations. It is, of course, necessary to have concise and standard definitions for each of the items, and in order that each foreman making out the cards may have a like understanding of the definition of the words, they have been carefully prepared and are as follows:

EDUCATION: Mental and moral training.
SPECIAL KNOWLEDGE:
HONESTY: Upright disposition or conduct.
MORALITY: Accord with the rules of right conduct.
TEMPERANCE: Moderation.
TACT: Ability to do or say what is best for the intended effect.
RESOURCE: Good at devising expedients.
RELIANCE: Sure dependence.
FORESIGHT: The act or power of foreseeing.
APPEARANCE: Outward look or aspect.
MEMORY: Mental hold on the past.
ENERGY: Active, effective.
INITIATIVE: The ability or disposition to take the lead.
PERSISTENCE: Steady or firm adherence to, or continuance in a state, course of action, or pursuit that has been entered upon.
ASSERTIVENESS: Affirming confidently; positive.
DISCIPLINE: To teach rules and practice and accustom to order and subordination.
PROMPTNESS: Quickness of decision or action.
ACCURACY: Correctness.
SYSTEM: Regular method or order.
ORGANIZATION: A systematic and regulated whole.
EXECUTIVE ABILITY: Ability to carry into effect in a practical manner.

These cards are made out by the line officers for each of their foremen and sent direct to the office of the superintendent motive power, where they are reviewed and placed on file. The foremen make out cards for each employee under them and these are reviewed and placed on file in the office of the line officer. It is evident that in order to have these records accurate the foreman must carefully study and observe each individual under him. Each foreman is supplied with just enough cards, and he does not keep any copy of his reports. He is thus forced to observe the men more closely in order that future reports may show accurately any improvement or falling off from the former ones.

This system has been in effect, in some of the branches of the department, for three years and has shown good results. First-class men with qualities which make them eligible for promotion, are in this way discovered and may be developed along the proper lines. The foremen are broadened and developed* by this study, and each one is encouraged to analyze more closely his work, disposition and character. Every man understands that these records are being kept and that they are studied by the men at the head of the department; they are thus encouraged to improve and better themselves. It is not unusual to make a brief notation at the bottom of the cards; thus—"should make a good man" appears on the card of one of the young men who is low in qualities which can be developed by application on his part; "will improve in time" and "good material" are also among the notations on some of the cards.

THE CLERICAL FORCE.

Duties of the Chief Clerk, or Secretary.

(*This section is condensed from an outline which was prepared for distribution among the chief clerks in the mechanical department.*)

The work of the secretary, or chief clerk, to a railroad official may be divided into four parts, as follows:

First, general correspondence, which occupies the greater part of his time.

Second, consideration of the larger details of the office, such as listening to and deciding important questions submitted by subordinates, analyzing reports and improving the organization.

Third, receiving callers.

Fourth, general duties.

First—Correspondence: The essentials in handling correspondence are familiarity with the subjects under discussion; regularity, punctuality, and carefulness. Too much emphasis cannot be placed on the necessity for thoroughly familiarizing

* As an illustration of this the following incident is cited. One of the foremen did not fill in all of the items on some of the cards. When questioned by his superior he said that he did not know the men well enough to express an opinion. The cards were returned to him and he was told to fill them in completely. He should be able by talking with the men and sizing them up closely to at least give an opinion on the various items. Before the next set of cards were received he would have time to study any questionable points and to revise his estimates. He was frankly told that in order to be promoted to a position where he would have to hire men he must cultivate the habit of sizing them up quickly and accurately.

FORM 2567 S. 195. 10m. 9-08. W&S

NAME O'Brien, John
EMPLOYED AT Elkhart
AS Machinist

	VERY GOOD	GOOD	MEDIUM	POOR
EDUCATION			●	
SPECIAL KNOWLEDGE	●			
EXPERIENCE	●			
HONESTY	●			
MORALITY	●			
TEMPERANCE	●			
TACT	●			
RESOURCE	●			
RELIANCE	●			
FORESIGHT	●			
APPEARANCE	●			
MEMORY		●		
ENERGY	●			
INITIATIVE		●		
PERSISTENCE	●			
ASSERTIVENESS		●		
DISCIPLINE	●			
PROMPTNESS	●			
ACCURACY		●		
SYSTEM	●			
ORGANIZATION	●			
EXECUTIVE ABILITY	●			

INDIVIDUAL EFFICIENCY CARD—A GOOD MAN.

oneself with all the work, as more time is wasted in handling unfamiliar subjects than in any other way. The chief clerk should be capable of handling, with a few pointers, almost any subject which might come up in the regular course of business. His letters should be clear and concise and yet of sufficient length to explain fully the subjects treated.

Up-to-date practice is for the chief clerk to go through the correspondence with his employer each morning and make such notations as he thinks necessary in order to properly reply to the letters. Correspondence which is likely to be desired in connection with any of the letters should be attached before submitting them. He should make sure before submitting either questions or statements that they have been very carefully prepared and that he has a full understanding of their meaning. He is thus in position to call attention to any unusual conditions and to make pertinent suggestions.

Second—Handling of Office Details: The first discovery that a man usually makes on receiving a new appointment is that if the day consisted of forty-eight instead of twenty-four hours, and every hour was devoted to office work, there would not be enough time to meet all the demands. It is therefore essential

FORM 2567 S. 195. 10m. 9-08. W&S

NAME Wilson, Puddenhead
EMPLOYED AT Boiler Maker
AS Asstabula

	VERY GOOD	GOOD	MEDIUM	POOR
EDUCATION	●			
SPECIAL KNOWLEDGE		●		
EXPERIENCE		●		
HONESTY	●			
MORALITY	●			
TEMPERANCE	●			
TACT			●	
RESOURCE			●	
RELIANCE		●		
FORESIGHT			●	
APPEARANCE	●			
MEMORY		●		
ENERGY		●		
INITIATIVE			●	
PERSISTENCE			●	
ASSERTIVENESS			●	
DISCIPLINE		●		
PROMPTNESS		●		
ACCURACY		●		
SYSTEM		●		
ORGANIZATION		●		
EXECUTIVE ABILITY		●		

INDIVIDUAL EFFICIENCY CARD—A GOOD MAN, BUT WOULD MAKE A POOR FOREMAN.

FORM 2567 S. 195. 10m. 9-08. W&S

NAME Zelinyski, Frank
EMPLOYED AT Moulder Apprentice
AS Collinwood

	VERY GOOD	GOOD	MEDIUM	POOR
EDUCATION				● +
SPECIAL KNOWLEDGE				● +
EXPERIENCE			+	●
HONESTY		●		+
MORALITY			●	+
TEMPERANCE			● +	
TACT				● +
RESOURCE			+	●
RELIANCE			●	+
FORESIGHT				●
APPEARANCE		●	+	
MEMORY		●	+	+
ENERGY				● +
INITIATIVE				● +
PERSISTENCE			● +	
ASSERTIVENESS			● +	
DISCIPLINE		●		+
PROMPTNESS			●	+
ACCURACY				● +
SYSTEM			●	+
ORGANIZATION				● +
EXECUTIVE ABILITY				● +

● = MARKS GIVEN BY SHOP INSTRUCTOR
+ = " " " DRAWING INSTRUCTOR

A COMBINATION OF TWO EFFICIENCY CARDS MADE OUT FOR AN APPRENTICE BY THE SHOP AND DRAWING INSTRUCTORS, SHOWING HOW CLOSELY THE MARKINGS AGREE IN GENERAL, ALTHOUGH THE CARDS WERE MADE OUT INDEPENDENTLY, AND WITHOUT CONFERENCE.

to economize time as the most precious commodity. This may best be done by adhering closely to the following maxims:

Subordinates should be chosen carefully and should be men who can be relied upon.

Harmony and good feeling are essential in all well regulated organizations and the conduct of the chief clerk is of prime importance in the building up of the organization.

He must be fully conversant with all the details of the work, but must not concern himself with details which his subordinates are just as well able to deal with as he is; he should reserve himself for such matters of moment as they are not competent to decide without his authority and experience.

Before any question is submitted to him for decision he should insist upon having all the facts placed before him, so that it will not be necessary for him to apply his mind to it a second time, but may decide it at once and for all.

He should not attempt to do two or more things at once. The

man in authority, who is constantly surrounded by a throng of subordinates and striving to meet all their demands at once, does not accomplish as much work as the one who steadily concentrates himself on one thing at a time, never wasting a moment and never getting flurried or hurried.

He should be contented and should not have his mind preoccupied by his own worries or fancied grievances. It is impossible to work to advantage under such conditions.

The duties of each member of the organization should be clearly defined, so that responsibility may be properly placed. The organization should be studied carefully in order to cut out all lost motion, friction and unnecessary work.

In order to develop each individual to the fullest extent it is necessary to increase his responsibility from time to time, as the work will permit. Initiative must be encouraged on the part of subordinates and all suggestions received from them should be treated with deference and interest.

Subordinates should be carefully studied and in a quiet way should be coached to assist them in improving weak points.

Third—Receiving Callers: The employer is often judged by the conduct of his secretary or chief clerk. One of the most important duties of a chief clerk is at all times to receive callers with courtesy; he should be readily accessible. As a rule all callers insist upon seeing the head of the department, and it is difficult to get them to even disclose the nature of their business to another person. The ideal chief clerk will handle them diplomatically so that, if necessary, they will leave the office without consuming too much of the time of his superior, and yet feel that they have been well taken care of.

Fourth—General Duties: The chief clerk must, of course, have the complete confidence of his employer, and to retain this it is necessary that all details be handled regularly, promptly and carefully. He should see that the rulings of the executive head of the department are promptly and properly promulgated and that they are followed by the other members of the organization.

The chief clerk to the superintendent of motive power, at Cleveland, holds stated meetings with the chief clerks of the various division officers, the object of these meetings being to gain a better understanding of their duties and to keep them in close touch with the central organization.

The chief clerk to the superintendent motive power has jurisdiction over the entire clerical force of the motive power department.

THE CLIPPING BUREAU.

A clipping bureau has been established as a permanent feature and in the campaign of education for building up the organization it played a prominent part. All the technical papers and magazines are carefully examined by a man especially qualified and articles of interest to any official or foreman are marked and a page reference made on the outside cover. This is especially true of articles in any way relating to organization problems. The papers are circulated and when finally returned to the office the articles are clipped and filed under their respective subjects for reference. Extracts of important articles are often reprinted or extra copies of the paper in which they appear are obtained and sent to the various officials. In some instances they are asked to give a written opinion of the article in question.

The idea of efficiency cards was discovered in this manner, a like system being in use in a large department store, the handling of which was described in one of the journals. Much of the subject matter in the article on duties of the chief clerk was collected from the clipping file.

In addition to the general library in the office of the superintendent motive power, branch libraries of well chosen technical books have been established at division headquarters, the idea being that books of this character are just as important as good machine tools or other equipment.

THREE-PHASE ELECTRIC LOCOMOTIVE.

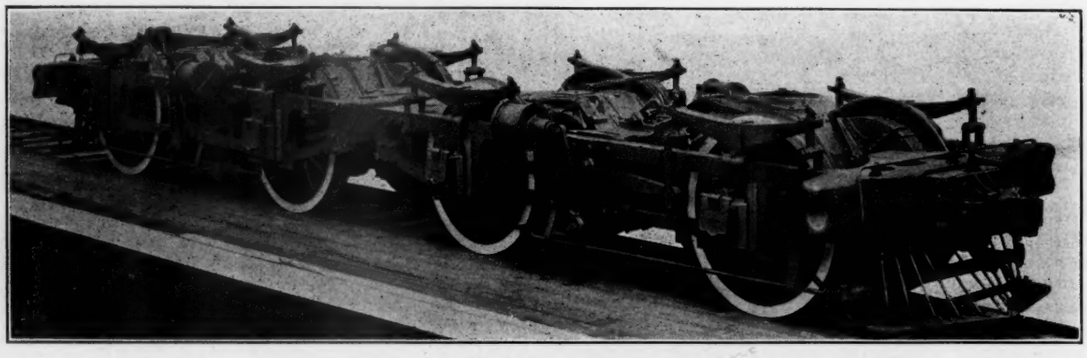
GREAT NORTHERN RAILWAY.

The first electric locomotives to operate under steam railroad conditions, using three-phase alternating current for power, have recently been delivered to the Great Northern Railway by the American Locomotive and General Electric Companies and will be used for hauling freight and passenger traffic through the Cascade tunnel. There are four locomotives or units in the order.

The Cascade tunnel is somewhat less than three miles in length and is so located as to forbid the introduction of ventilating shafts, which, taken in connection with the fact that there is a 1.7 grade in one direction through it, makes steam locomotive operation very undesirable, particularly in passenger traffic. Electric operation, however, overcomes this objection perfectly and, although electric locomotives will be used simply through the tunnel at present, plans are being formulated for also electrically operating several other grades in the vicinity.

The locomotives, as can be seen in the illustration, are of the double truck, four driver type and weigh 230,000 lbs. They differ from previous locomotives of this wheel arrangement, however, in the fact that the two trucks are connected to each other in the center and incorporate the draft gear and couplers within their frame. In this way the whole pulling stress is delivered directly through the truck frames and does not come upon the cab underframe at all. The use of the articulated connection, of course, alters the relative positions of the two center pins in rounding curves, and it has been necessary to arrange for a longitudinal movement at one of them, which, since there is little stress on the pin, is very easily taken care of.

Four 400 h.p. three-phase induction motors are provided, each driving one pair of driving wheels through a double set of spur gearing, the secondary circuit to each motor being mounted on a shaft which carries a pinion gear at each end. These pinions mesh with gear bands shrunk on an extension of the driving wheel centers, the gear ratio being 1 to 4.28. The motors are wound for eight poles and when operated at 25 cycles have a synchronous speed of 375 r.p.m., which gives a locomotive speed of about 15½ miles per hour. The trolley voltage will be at 6,600 volts, which is transformed to 500 volts for use at the motors.



RUNNING GEAR—GREAT NORTHERN THREE-PHASE ELECTRIC LOCOMOTIVE.

The truck frames are of cast steel and are made very heavy

THREE-PHASE ELECTRIC LOCOMOTIVE—GREAT NORTHERN RY.

and substantial. There was no desire to save weight at any point, as it was even necessary to add extra ballast to the locomotive to obtain sufficient adhesion. The frames of the two trucks are interchangeable, although the equalizing systems are different. Both trucks carry semi-elliptical springs over the journals, which in one case are equalized together on one side of the truck, and in the other are equalized across the trucks, the two springs over the journals on the same axle being equalized together.

The arrangement of the apparatus and controlling devices within the cab of the locomotive has been made as simple as possible. The transformers, contactors, blowers, air compressors, etc., are placed within a fireproof compartment located in the center of the cab, having a wide passage-way on all sides. The engineer's controller and indicating apparatus are located in the usual place in the right-hand corner on either end. The transformers are of the air-cooled, two-coil type, a motor-driven centrifugal blower being provided, which gives low pressure air for cooling the transformers, contactors and motors. It might be mentioned that the designers of the electrical features of this locomotive were not hampered by a desire to obtain great economy, since a liberal supply of power is obtained from a hydro-electric plant located on the Wenatchee River, about 30 miles away. The current is transmitted at 30,000 volts, and stepped down by transformers at the mouth of the tunnel to 6,600 volts. Under those conditions the electrical equipment could be made of the simplest and most substantial type.

As will be noted in the illustration, the locomotive is equipped with four trolleys, two of which will be used for operation in either direction, the rail being employed as a third conductor. One of the advantages of the three-phase equipment is the tendency to operate at a constant speed, which in this case is about 15 miles per hour. In going down grade this speed is maintained by the regenerative tendency of the motors, which will return a certain amount of energy to the supply system.

The locomotives under test have shown themselves to be capable of exerting three times the guaranteed full load running torque at any speed from a standstill to within a few per cent. of synchronism.

They have the following general dimensions:

Total weight	230,000 lbs.
Length over couplers	44 ft. 2 in.
Length over cab	40 ft. 1¾ in.
Height of cab	14 ft.
Width over all	10 ft.
Total wheel base	31 ft. 9 in.
Rigid wheel base	11 ft.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.

On November 20, a meeting was held in the parlors of the Auditorium Annex Hotel, Chicago, for the purpose of forming a fuel association for the railroads of the United States, Canada and Mexico. Forty-one persons were present. It was decided to call it The International Railway Fuel Association. A constitution and by-laws were adopted; the first annual meeting will be held in June, 1909.

The object of the Association will be to advance the interests of the employer by recommending the adoption of the best methods of purchasing, inspecting, weighing, distributing, handling and accounting for fuel. The constitution is so framed as to include in the Association as associate members, officials or representatives of concerns engaged in the production of fuel, either coal or oil, fuel handling devices and equipment, weighing and fuel consuming or labor saving devices.

The following officers were elected: President, Eugene McAuliffe, general fuel agent, Rock Island-Frisco Lines, Chicago; first vice-president, Thomas Britt, general fuel agent, Canadian Pacific Ry., Montreal; second vice-president, G. R. Ingersoll, purchasing agent, L. S. & M. S. Ry., Cleveland; secretary, D. B. Sebastian, fuel supervisor, C. & E. I. R. R. and E. & T. H. R. R., 327 La Salle street station, Chicago; treasurer, J. McMahamy, road foreman of engines, Pere Marquette Ry., Grand Rapids, Mich.; executive committee for two years, C. F. Richardson, fuel agent, St. L. & S. F. R. R., St. Louis; S. L. Yerkes, fuel agent, Queen & Crescent System, Lexington, Ky.; J. H. Hibben, fuel agent, M. K. & T. R. R., Parsons, Kan.

M. M. AND M. C. B. CONVENTIONS.

The executive committees of the Railway Master Mechanics' and the Master Car Builders' Associations met in New York City, on November 20, and decided to hold the 1909 conventions in Atlantic City, N. J., June 16 to 23; the Master Mechanics' convention to be held first.

The executive committee of the Railway Supply Manufacturers' Association met on the same day and decided upon Young's Million Dollar Pier for the place of the convention meetings and the exhibits.

At the request of the executive committees of the M. M. and the M. C. B. Associations, action was taken by the executive committee of the Railway Supply Manufacturers' Association forbidding the distribution of souvenirs at the conventions.

Application for exhibit space should be made to Earl G. Smith, secretary of the Railway Supply Manufacturers' Assn., 345 Old Colony Building, Chicago.